2. The Draft EFH Assessment (pg. 67) states that habitats that would be removed exhibited some of the "lowest density use by both coho and sockeye salmon juveniles" within the SFK drainage, suggesting "low overall quality EFH or abundance of quality habitat in unaffected areas." We recommend that additional information be provided to support these conclusions. Specifically, we recommend that the Corps present fish sampling data as catch-per-unit effort values, rather than as density use; present data on seasonal fish distributions; present data on habitat quality within the project waters; and discuss whether the DEIS and the Draft EFH Assessment evaluated and compared habitat characteristics at sites where fish were and were not observed.

3. The Draft EFH Assessment (pg. 67) asserts that, considering the low use of EFH and direct habitat losses in the SFK-E reach and the NFK 1.190 tributary, "drainage-wide impacts to Pacific salmon populations from these direct habitat losses would be unlikely." We recommend that evidence be provided that supports this conclusion.

4. The Draft EFH Assessment concludes that the Pebble Project may adversely affect EFH. However, the Assessment also concludes that "…mortalities are unlikely and EFH characteristics would return to normal shortly after the activity ceases, or in the short term" (pg. 120) and that "habitat removed is generally of low biological importance." We recommend that the Corps should either explain or resolve this apparent discrepancy and include references or documentation to support these assertions.

Geospatial Mapping of Habitat: The DEIS does not include geospatial representation (i.e., the location and spatial arrangement) of assessed baseline fish habitats. Such geo-location of classified habitats, analyzed by their functions for individual species, is needed to understand how the project will affect habitat availability, spatial arrangement, and connectivity, which in turn will determine impacts to fish populations. We recommend that the EIS document the location of existing baseline fish habitats, their proximity to other similar or dissimilar habitats required by those fish, and how the spatial arrangement of these habitats will change as a result of the proposed mine project. Alternatively, we recommend that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Headwater Streams: The DEIS and the Draft EFH Assessment do not address the effects of decreased inputs from headwater streams on downstream waters. Headwater streams support numerous fish species and habitats, and the disruption to headwater streams from the mine site has the potential to result in large environmental consequences to fish and aquatic resources at a scale beyond that included in the Mine Site EIS Analysis Area (Figure 3.24-1). We recommend that the EIS include discussion of the extensive body of scientific evidence demonstrating that headwaters are critical aquatic habitats,[15] and evaluate the role and importance of headwater streams in the project area in terms of both direct use of these habitats and their inputs to downstream waters. Alternatively, the Corps should explain why its existing consideration of headwater streams is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Intermittent Stream Reaches: The DEIS does not analyze intermittent stream surface and groundwater flow pathways relevant to fish and fish habitat. Intermittent streams may lack flow during critical summer low flow periods and are often viewed as having limited ecological function for fish habitat or

[15] For example, Section 7.2.3.2 in EPA 2014.

water quality when surface flow ceases. However, hyporheic flow composed of mixed shallow groundwater and surface water under and along the channel bed can continue in these intermittent channels after surface flow has ceased. This hyporheic flow can be thermally moderated (i.e., buffered from the effects of solar heating by the channel substrate),[16] and thus can create thermally distinct fish habitat in isolated pools in intermittent streams.[17] The literature supports the idea that intermittent streams can provide high quality habitat. Subsurface flow can also increase thermal heterogeneity where it emerges at confluence zones with perennial water bodies, such as lakes[18] or streams and rivers,[19] providing patches of cold-water habitat in otherwise warm downstream waters. The functional role of colder tributaries in providing thermally distinct water that supports cold water fish species is a clear example of an ecosystem service provided by the tributaries,[20] potentially even after surface flow has ceased in an intermittent stream reach. We recommend that the EIS evaluate the potential importance of intermittent stream reaches, which are seasonally important for fish migration, spawning, and rearing as part of stream-lake networks, in the project impact area or the Corps should explain why its existing consideration of intermittent streams is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS states that the mainstem SFK has a 10-mile reach, from two miles below Frying Pan Lake to the SFK Tributary 1.19, that frequently exhibits zero or intermittent flow during winter and summer months. The DEIS states that the loss of surface water in this reach transfers an average of 22 cfs from the SFK (Nushagak River headwaters) into the UTC (Kvichak River headwaters) via groundwater exchange, indicating complex hydrological connections. Groundwater remaining in the SFK basin reemerges at the downstream end of the intermittent reach, 20 miles above the NFK confluence. The DEIS states that this reach is not considered "quality" habitat for purposes of environmental review (pg. 3.24-9), but this conclusion is not supported within the DEIS. As discussed above, the scientific literature supports the conclusion that intermittent stream reaches can be seasonally important for fish migration, spawning, and rearing[21] as part of stream-lake networks. Furthermore, the DEIS states that the highest densities of chum salmon redds occurred in the reach immediately downstream of the dry channel (SFK-C), where accretion of groundwater is most evident.[22] The DEIS does not present the data or other information on stream habitat that were analyzed to reach the conclusion that the intermittent stream reach does not represent quality habitat. We recommend that the EIS evaluate the intermittent reach on the mainstem SFK, between SFK Tributary 1.19 and the outlet of Frying Pan Lake, as potential habitat for Chinook, sockeye, and chum salmon and resident fish. Alternatively, we recommend that the Corps explain why its analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Off-Channel Habitat: The DEIS does not quantify off-channel floodplain habitats or disclose models that will be used to account for off-channel habitats, even though off-channel habitats can be an extremely important factor in salmonid distribution.[23] Tables 4.24.2 and 4.24.3 assert that there will be an increase in downstream spawning and rearing habitats, but the DEIS does not provide scientific evidence supporting this claim. We recommend that the EIS document and quantify pre-existing off-

[16] May and Lee 2004, Arrigoni et al. 2008.
[17] Bilby 1984, May and Lee 2004.
[18] Buttle et al. 2001.
[19] Ebersole et al. 2015.
[20] Torgersen et al. 2012.
[21] *Id.*
[22] R2 et al 2011a.
[23] For example, Swales and Levins 1989.

channel habitats that may be affected by the project, analyze potential losses of off-channel habitats due to the project, and address the consequences of these habitat losses to fish populations. We recommend that results from the Pebble Project Draft Environmental Baseline Studies 2006 Study Plan be used to help illustrate the mechanics of flow connectivity to the channel from surface flow, groundwater flow, or both combined. For example, Figure 11.1-3 of PLP 2006 includes a map of off-channel habitat transects from the SFK River. Alternatively, the Corps should explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Fish

Distribution and Abundance: The DEIS and the Draft EFH Assessment do not characterize the full seasonal distribution and abundance of resident and anadromous fish or capture interannual variability in these parameters. Because the distribution and abundance of fish can vary substantially both seasonally and interannually, and because the project will affect the area in perpetuity, long-term data on fish distributions and abundances are needed to evaluate impacts of the project. We recommend that the EIS analyze the full seasonal and interannual variability in distributions and abundances of fish species and assemblages that are supported by the diversity of habitats in the Nushagak and Kvichak River watersheds, including habitats in the headwater streams of the SFK, NFK, and UTC over multiple years. Alternatively, the Corps should explain why its existing analysis of spatial and temporal variability in fish abundances and distributions is sufficient in light of the significance and complexity of the discharge activities associated with this project. Specific recommendations include:

1. Fish may be absent from a site during some years or some portions of a single year, but present in high abundances at other times. Low abundance at one point in time does not necessarily equate to low abundance at another point in time, nor does it mean that the habitat is not ecologically important. We recommend that the EIS explain the seasonal and interannual distributions and abundances of fish species in terms of migration, spawning, incubation, rearing, and overwintering habitat within streams affected by the Pebble Project, including those affected by the withdrawal, storage, and discharge of water. When abundance and distribution data are presented, we recommend that the Corps specify how that data was generated (e.g., in terms of sampling frequency).
2. The DEIS includes little data on fish densities (see DEIS Sections 3.24 and 4.24), although density data is available.[24] The statements that are included in the DEIS are qualitative and unsupported. We recommend that the Corps include relevant data collected by PLP and supplement their analysis with relevant data collected by others.[25]
3. The DEIS states (pg. 4.24-3) that rearing Chinook salmon have been documented in the 2.9 miles of NFK Tributary 1.19 in lower densities (0.11 fish/100m^2) compared to the mainstem NFK (4.99 fish/100m^2) but does not include a citation to support this statement. These estimates appear to conflict with research conducted by ADF&G in the Nushagak River watershed that concludes that juvenile salmon are likely more abundant in the tributaries and headwaters of the

[24] For example, Tables 7.1-7.3 in EPA 2014, which show data from PLP's Environmental Baseline Document.
[25] For example, Woody and O'Neal 2010.

drainage, where finer scale habitat such as riffles and woody debris are more common.[26] We recommend that the EIS consider this ADF&G report and provide supporting information for the above referenced statement.

4. The Draft EFH Assessment states that no adult Pacific salmon were observed within the headwater reach of the SFK River that would be eliminated by the Pebble Project during the 2004-2008 aerial surveys to document adult salmon distribution (pg. 67). Aerial surveys can substantially underestimate salmon abundances in narrow, deep, highly vegetated, or tannic waters.[27] Inclusion of supplemental survey methods such as mark-recapture can help identify error and bias in estimates.[28] We recommend that the EIS include discussion of the limitations of aerial surveys and how these limitations could impact conclusions made in the EFH Assessment and in the EIS (i.e., by underestimating salmon counts in headwater streams).
5. Fish abundance estimates from the Environmental Baseline Document (Figure 15-1-96; PLP 2011) suggest that over 80,000 returning sockeye salmon were counted during one aerial survey in UTC and Tributary 1.60. This estimate, combined with remaining adult aerial counts, suggest that over 100,000 spawning sockeye salmon were counted in UTC alone in 2008, but this information is not included in the DEIS. We recommend that the EIS include these and other existing project-specific fish abundance estimates in the record

Bristol Bay Salmon Portfolio: The DEIS and the Draft EFH Assessment do not fully analyze population level effects from the potential loss of genetic diversity of the Bristol Bay salmon portfolio.[29] The Pebble Project could result in population-level effects on the genetic diversity of salmon stocks in the Nushagak and Kvichak River watersheds, which in turn could impact the salmon portfolio and overall resilience of salmon populations within the Bristol Bay watershed. Thus, additional information on the genetically distinct fish populations in the project area is needed. We recommend that the EIS analyze the relative contribution of genetically distinct spawning populations to determine the significance of population losses or reductions that may result in impacts beyond recovery thresholds of species.[30] We recommend that the EIS also analyze and discuss existing scientific information on the Bristol Bay salmon portfolio and the consequences of genetic biodiversity losses for salmon populations. Alternatively, the Corps should explain why its existing discussion of genetic diversity and the portfolio effect in the Bristol Bay region is sufficient in light of the significance and complexity of the discharge activities associated with this project. Specific topics that we recommend the EIS discuss and evaluate include:

1. There are several hundred discrete sockeye salmon populations in Bristol Bay.[31] It is possible that as many as 200 to 300 discrete sockeye salmon spawning aggregates occupy the Kvichak River system alone.[32] The heterogeneity of these Kvichak River populations reduces the

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[26] For more information about this research see: http://www.adfg.alaska.gov/index.cfm?adfg=chinookinitiative_nushagak.main#juvenileabundance
[27] Bevan 1961.
[28] For example, Parken et al. 2003.
[29] Schindler et al. 2010.
[30] *Id.*
[31] *Id.*
[32] Habicht et al. 2004; Ramsted et al. 2004; Ramstad et al 2009.

variability of sockeye salmon returns in the Bristol Bay region and contributes to the stability and robustness of the resource.

2. ADF&G has built and tested the Bristol Bay salmon genetic baseline over the past 17 years.[33]
3. Recent research indicates that sockeye and Chinook salmon productivity vary over space and time in the Nushagak River drainage, and that shifting habitat mosaics throughout the drainage, including streams draining the project area, help stabilize interannual salmon production.[34]

Population Level Effects: The DEIS Summary for Habitat Loss (Section 4.24.2.1) concludes that modeling indicates that "indirect impacts associated with mine operations would occur at the individual level and be attenuated upstream of the confluence of the NFK and SFK with no measurable impacts to salmon populations" (p. 4.24-6). Standard fisheries management techniques are applied at the population level, not the individual level, and the approach mentioned in the DEIS is inconsistent with ADF&G population/stock management approaches. The DEIS also does not provide fish population estimates or the models used to support the determination that impacts would occur at the individual level rather than at the population level. We recommend the EIS clarify the distinction between individual-level and population-level effects and include supporting information for the conclusion that there would be no measurable impacts to salmon populations. Alternatively, we recommend the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Temporal Availability of Salmon: The Pebble Project proposes to eliminate, dewater, block, and fragment headwater streams, which could result in the loss of habitats that support headwater spawning and rearing salmonid populations. Headwater stream populations arrive later to their spawning grounds than those downstream in the mainstem and lower tributaries. Later arriving salmon populations are important because they extend the seasonal availability of salmon to terrestrial wildlife (e.g., bears, wolves) and other aquatic biota (e.g., fish and invertebrates) in the NFK, SFK, and UTC, and the overall Nushagak and Kvichak watersheds. Predators and scavengers roam from lakes to mainstems to tributaries in search of food subsidies offered by asynchronous salmon run timings across the landscape. The DEIS does not evaluate the importance of late arriving salmon to the ecology of headwater and downstream areas or of the potential consequences of losses due to the project. We recommend the EIS evaluate the importance of late arriving salmon to the ecology of headwater and downstream areas and the potential consequences of losses of these asynchronous subsidies due to the project or the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Age Structure: The DEIS acknowledges the presence of multiple age classes of Chinook, coho, and sockeye salmon in the Nushagak and Kvichak River watersheds. As a result, project impacts may result in losses of multiple age classes of multiple species. This loss of age class representation could significantly impact annual production or returns within a few generations. This issue is currently not evaluated in the DEIS. We recommend that the EIS analyze the potential for losses of multiple age classes, including across multiple species, and the potential resulting depletion of annual returns or that the Corps explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

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[33] For more information see: http://www.adfg.alaska.gov/index.cfm?adfg=fishinggeneconservationlab.bbaysockeye_baseline
[34] Brennan et al. 2019.

Egg Incubation: The DEIS and the Draft EFH Assessment do not fully address egg incubation or potential impacts to incubating fish eggs from habitat alterations. While the DEIS analyzes timing of spawning, egg incubation is a different life stage that occurs during a different time period. Table 3.24-4 does not include egg incubation, and thus this table presents an incomplete picture of life-stage periodicities of fish species in the NFK, SFK, and UTC watersheds. In addition, egg incubation could be affected by several project induced physical and chemical alterations, including changes in water temperature, groundwater inputs/flow pathways, surface flows, dissolved oxygen, pH, conductivity, and other water quality parameters. We recommend the EIS add egg incubation to Table 3.24-4, between spawning and emergence periods and that the EIS evaluate potential impacts to incubating eggs from changes in flow (e.g., scour) and other physical and chemical project induced alterations, as well as the consequences of the potential impacts to incubating eggs for fish species and populations. DEIS Table 4.24-1, which presents "Priority species and life stages used to determine habitat flow needs in the mine site area," should be revised to include the incubation life stage for all species documented to occur in potentially affected waters, including lamprey (resident and anadromous). The analysis of impacts to lamprey are important because lamprey eggs hatch into larvae (ammocoetes) in about two weeks' time and drift downstream to slow velocity areas, where they reside in the substrate from three to seven years, resulting in multiple age classes in the substrate at once. Lamprey eggs and ammocoetes, as well as eggs of other nest-building fish species, can be impacted by high flows that scour redds during sensitive life stages. We recommend that Table 4.24-3, entitled "Average precipitation year juvenile habitat for all streams and species in the mine site area pre-mine, during operations, and post-closure," be revised to include all species documented at the mine site area.[35] Alternatively, we recommend that the Corps explain why its existing consideration of egg incubation is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Resident and Anadromous Fish: The DEIS discloses that potential direct and indirect (i.e., secondary) effects for aquatic resources are assessed according to the magnitude of impact from the project depending on the specific species sensitivity to the type of disturbance (p. 4-24-1). However, only select species are mentioned and several species that would be impacted are not included. As a result, the DEIS presents an incomplete picture of the number of impacted fish species and underestimates direct, secondary/indirect and cumulative impacts to the diversity of species and assemblages that provide ecological sustainability to the NFK, SFK, and UTC watersheds. We recommend that the EIS analyze impacts for the full diversity of resident and anadromous fish species known to occur in the Nushagak and Kvichak River watersheds or explain why its existing focus on selected species is sufficient in light of the significance and complexity of the discharge activities associated with this project.

DEIS Table 3.24-4 presents periodicity information only for select species. This table is incomplete and does not sufficiently represent periodicity because the length of time between spawning and fry emergence varies with species, population, and water temperature.[36] We recommend that the EIS include the complete periodicity of critical life stages of all anadromous and resident species known to occur in the mainstem and tributaries of the Nushagak and Kvichak River watersheds in Table 3.24-4 or explain why its existing focus on selected species is sufficient.

[35] Woody and O'Neal 2010.
[36] Murray and McPhail 1988, Quinn 2004.

DEIS Figures 3.24-2 and 3.24-3 present the fish distribution and relative contribution of "anadromous salmonids," "resident salmonids," "non-salmonid fish," and "no fish observed." The DEIS does not clearly define these terms, which differ from the regulatory language of the ADF&G Anadromous Waters Catalog. We recommend that the EIS define the categories used in Figures 3.24-2 and 3.24-3. For comparative purposes, we recommend that the EIS refer to life history strategies as either "anadromous" or "resident," consistent with the ADF&G Anadromous Waters Catalog. We also recommend that the EIS clarify whether "no fish" means that the reaches were sampled and no fish were found (and if so, when and how frequently these reaches were sampled), or that reaches were not sampled. Alternatively, the Corps should explain why its existing categories are sufficient in light of the significance and complexity of the discharge activities associated with this project.

Life History Strategies: The DEIS does not disclose potential impacts to life history strategies. Some fish species (e.g., rainbow trout, least cisco, Dolly Varden char, three-spine stickleback, lamprey) exhibit both resident and anadromous forms, each with diverse habitat needs for successful completion of life cycles. Resident and anadromous forms of lamprey were documented in the NFK, SFK, and UTC during the 2007 Baseline studies.[37] The presence of lamprey has also been documented in these headwater streams.[38] Anadromous Dolly Varden have also been documented in Bristol Bay watersheds.[39] We recommend that the EIS analyze life history strategies of the fish species documented to occur in the project impact area, consider potential impacts of the project to these life history strategies, and explain whether anadromous populations of these fish are also present within the Nushagak and Kvichak River watersheds. Alternatively, the Corps should explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not analyze potential impacts to diverse fish spawning strategies (e.g., nest builders versus broadcast spawners; spring versus fall spawners). For example, salmonids and lamprey species build redds in the channel substrate. Least cisco are broadcast spawners with eggs that disperse in the water column. Coho salmon are fall/winter spawners, while rainbow trout are spring spawners. Adaptive spawning strategies may not be resilient to the physical and chemical alterations resulting from the project. We recommend that the EIS analyze impacts of the project to the diversity of spawning strategies known to be used by fish species documented in the project area and resulting changes to the overall ecology of fish populations and assemblages or explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Bivalves: The DEIS does not discuss the presence or absence of freshwater mussels in the Bristol Bay region, nor does it analyze project impacts to bivalves. The Pebble Project Draft Environmental Baseline Studies, 2006 Study Plan, Figure 11.5-1, presents a map of the 2005-2006 project freshwater mussel sampling locations for Lake Iliamna. We recommend that the EIS characterize the pre-existing bivalve populations and analyze potential impacts to bivalves from the project or explain why its existing analysis is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Sampling Design: The DEIS does not describe site selection and sampling design for fish habitat, distribution, or relative abundance studies. The DEIS does not explain methodologies used for the

[37] Northern Dynasty Minerals 2007.
[38] Woody and O'Neal 2010.
[39] Lisac and Nelle 2000, Reynolds 2000, Taylor et al. 2008.

selection of habitat transects (i.e., random, systematic) or if there was statistical reasoning behind the study transect selection. In addition, levels of uncertainty and error are not consistently reported for data used in the analysis. Fish counts reported in PLP's Environmental Baseline Document[40] do not always include estimates of observer efficiency, sampling efficiency, or other factors that affect the proportion of fish present observed. Thus, counts may often underestimate true abundance. The DEIS also includes limited or no information regarding when samples were collected, how many were collected, how often they were collected, and overall sample size on which estimates were based. This information should be included within the DEIS to support its statements. We recommend that the EIS provide information on site selection and study sampling designs and associated levels of uncertainty and error, as well the above-mentioned sample reporting information, for all data included in the DEIS, because this information is necessary to understand and support the presented analysis. Alternatively, the Corps should explain why its existing presentation of sampling design information is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Impacts of Streamflow Alterations: The project proposes to directly alter the natural flow regimes of streams that support resident and anadromous fish. A stream's flow regime—its daily, seasonal, annual, and flood fluctuations—is key to stream structure and function; thus, assessing impacts based only on mean monthly streamflows at large spatial scales does not adequately capture impacts. Numerous case studies in the literature indicate that altering a stream's hydrograph can cause measurable changes in ecosystem structure.[41] Streamflow changes are characterized in the DEIS using changes to monthly and annual mean flows. Fish habitat is created and maintained through daily and seasonal variations (e.g., minimums and maximums) of the natural hydrograph and therefore the time scale used in the DEIS does not capture flow impacts on fish. Reporting mean monthly values alone does not represent the range of flows that occurs each month or during extreme precipitation or drying events. We recommend that the EIS model flow alterations associated with the project on a more conservative basis, such as a daily or diurnal basis, to fully predict potential impacts on fish. We recommend that the EIS also characterize flow alterations such that pre-existing, mine operation, and post-closure hydrographs can be compared in terms of changes in the frequency or magnitude of daily peak and minimum flows. To support this analysis, the EIS could include a table that identifies: stream, reach, length (miles), percent and absolute (cfs) streamflow alteration (in terms of monthly mean, minimum, and maximum flows), and fish species and life stages known to be present. We recommend that the EIS include one or more maps of streams in the mine area that illustrate the specific percent streamflow changes expected along those streams (e.g., see Figure 7-14 in EPA 2014). Alternatively, the Corps should explain why its existing analysis of flow alterations is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS does not explain how flow alterations may alter ice formation in the Nushagak and Kvichak River watersheds. The DEIS does not include information on locations, thickness, or movement of ice; timing of break up and ice-out; under-ice temperatures; or under-ice spawning and overwintering habitat. We recommend that the EIS evaluate the project's potential impacts on the ice-related factors discussed above or explain why its existing consideration of ice-related factors is sufficient in light of the significance and complexity of the discharge activities associated with this project.

The DEIS asserts that increasing flow will only result in positive benefits by increasing habitat. However, increasing flow can have negative effects as well (e.g., via temperature changes, redd

[40] PLP 2011.
[41] Richter et al. 2012.

scouring, and changes in channel stability and form), and it is well established that for many species and life stages, increasing flow does not create more habitat. In addition, the timing, frequency, and duration of increased flows should be considered. We recommend that the EIS further evaluate the extent to which increasing flow will result in potential positive benefits for the species and life stages impacted, as well as the potential negative impacts that could result from flow increases, in terms of the magnitude, timing, frequency, and duration of these changes. Alternatively, the Corps should explain why its existing analysis of the impacts of flow increases is sufficient in light of the significance and complexity of the discharge activities associated with this project.

According to Draft EFH Assessment, the net changes to habitat are expected to be negative across species in an average year and even greater in a dry year. The Draft EFH Assessment (Table 5-3) includes a nine percent decrease of spawning habitat for all four salmon species (Chinook, sockeye, coho, chum) in a dry year. We recommend that the EIS revise or provide supporting information for assertions in the DEIS that the Pebble Project will increase habitat, to accurately reflect analyses showing net habitat decreases. Alternatively, the Corps should explain why its existing analysis is sufficient and accurate in light of the significance and complexity of the discharge activities associated with this project.

In considering mine site impacts on fish resources, the DEIS states that the EIS analysis area (the NFK, SFK, and UTC watersheds, plus a 1,000 ft buffer around the mine site) includes "all aquatic habitats potentially impacted by changes in streamflow from the diversion, capture, and release of water associated with the project that result in a modeled reduction of streamflow greater than 2 percent" (pg. 4.24.-1). We recommend that the EIS provide rationale for why this two percent threshold was selected, the spatial or temporal scale at which this two percent value was calculated, how these delineations were supported by modeled streamflow changes, or whether this area also encompassed streamflow increases greater than two percent, and why it is considered a scientifically defensible threshold for considering impacts to fish resources.

The DEIS states that approximately 2.3 miles of the Tributary 1.190 mainstem and sub-tributary stream channels will remain free-flowing between the TSF and the water seepage pond, and that this could be resident species habitat (Section 4.24.2.1 Habitat Loss – North Fork Koktuli). We recommend that the EIS explain how this stream segment will remain free-flowing if it is blocked on both ends by mine structures, the upstream end of which is designed as a flow-through system such that water in this segment would be, in part, mining process water from the TSF.

The DEIS estimates the potential extent of downstream flow-related impacts of the project. The estimate, however, is unsupported. The DEIS states that "[o]nce the mainstem of the Koktuli is reached, flow changes would not be detectable" (pg. 4.24-13). The EPA's review finds that the DEIS does not contain any support for this conclusion, and that the DEIS does not define 'detectable.' We recommend that the information be added to support this statement regarding downstream flow-related impacts and revise or clarify as necessary.

According to the DEIS surface water modeling chapter (Appendix K.17 and RFI 104), the margins of error for flow model results are high; for example, the maximum difference between actual and modeled flows is approximately 20 percent. We recommend that the EIS, both graphically and tabularly, display flow changes (increases and decreases) for all project phases to show the extent (i.e., 3, 5, and 10 percent) and degree of downstream flow. We also recommend that the EIS show how changes in

effluent discharges may result in fish habitat changes, taking into account the 20 percent margins of error in the flow model. Alternatively, the Corps should explain why its existing analysis of flow alteration is sufficient in light of the significance and complexity of the discharge activities associated with this project.

Water Quality Impacts on Fish

Water Chemistry: The DEIS lacks analyses of the potential for fish toxicity from the introduction, relocation, or increase in contaminants in the aquatic environment. Anadromous and resident species are genetically adapted to a relatively narrow and unique range of habitat and water quality parameters within their natal streams.[42] We recommend that the EIS analyze: 1) potential impacts of increased metal loading to fish; and 2) how increases in loading, especially of copper and selenium, would affect fish downstream of the discharge points. We recommend that the level of chemical alteration and potential consequences to fish and fish habitat be evaluated. Alternatively, the Corps should explain why its existing analysis of metal loading and impacts on fish is sufficient in light of the significance and complexity of the discharge activities associated with this project. Additional technical recommendations include:

1. The Pebble Project proposes to treat all discharges to meet water quality standards. The Corps should analyze the potential for discharges to match the existing water quality of the receiving waters. Discharges that meet standards may still impact fish and fish habitat. For example, small changes, such as increases in dissolved copper concentrations, can be lethal or sublethal.[43] In order to improve thia analysis, the Corps should predict changes to concentrations in streams due to project impacts (such as treated water discharges, fugitive dust, and uncaptured groundwater) and evaluate the impacts that these changes could have on fish and fish habitat.
2. DEIS Section 3.24.1, Fish Tissue Trace Element Analysis, does not provide summary baseline or existing concentrations of elements (i.e., zinc, copper, arsenic, mercury, methylmercury). The Pebble Project Draft Environmental Baseline Studies 2006 Study Plan (Figure 11.1-1) includes a map of fish tissue sample site locations and the Draft 2007 Environmental Baseline Studies include a table of fish tissue sample locations (Table 11.1-2). We recommend that the EIS include this information to support analysis of potential impacts to fish from elevated elements.
3. Neither the DEIS nor the Draft EFH Assessment include analyses and discussion of potential toxicity impacts to fish. We recommend that the EIS analyze the potential for the following toxicity impacts:
    - Impairment to olfaction and homing capabilities in salmonids;
    - Attraction to very high lethal levels of water contamination;
    - Interference with respiratory function;
    - Reduction in immune efficiency;
    - Disruption to osmoregulation capabilities;
    - Impacts to the sensitivity of the lateral line canals;
    - Impairment of brain function; and

[42] Woody 2018; Lytle et al. 2004.
[43] Eisler 2000, Baldwin et al. 2003, Sandahl et al. 2006, Hecht et al. 2007, Sandahl et al. 2007, Tierney et al. 2010.

- Changes in enzyme activity, blood chemistry, and metabolism.

Water Temperature: The DEIS and the Draft EFH Assessment do not analyze how disruption in groundwater pathways, surface water flow, and aquifers will alter water temperatures and thermal patterns within the NFK, SFK, and UTC watersheds. Fish are at risk from changes in the heterogeneity of thermal patterns, which drive their metabolic energetics. Fish populations rely on groundwater-surface water connectivity, which has a strong influence on stream thermal regimes throughout the Nushagak and Kvichak River watersheds and provides a moderating influence against both summer and winter temperature extremes (Woody 2011). We recommend that the EIS characterize existing baseline heterogeneity of the water temperature regime and what this heterogeneity means for fish and fish habitat, including analyses of the regulating effects of groundwater/surface water connectivity. We recommend that the EIS analyze how flow alterations will affect pre-existing daily thermal regimes, as well as consequences for fish. A color-coded thermal map of the existing water temperature regimes versus those under the project operations would be helpful to show changes that could occur with project implementation. Alternatively, the Corps should explain why its existing analysis of temperature changes and impacts to fish is sufficient, in light of the significance and complexity of the discharge activities associated with this project. Additional technical recommendations regarding water temperature include:

1. The Draft EFH Assessment Table 5-4 presents a range of average stream water temperatures pre-mine and after release of treated surplus water during winter and summer. We recommend that this analysis be revised to include temperature variability (i.e., changes in daily minimum and maximum temperatures). Broadly characterized winter and summer average temperature ranges are not relevant to disclosing changes in thermal patterns to which NFK, SFK and UTC resident and anadromous fish are locally adapted. We also recommend that the EIS analyze potential short-term effects of water temperature increases during dry years.
2. We recommend that the EIS analyze impacts of temperature alteration to critical life history stages of fish species, particularly in terms of changes in incubation conditions and accumulated thermal units necessary to complete egg development. Egg development is a sensitive life stage and water temperature differences of one degree Celsius can impact growth and development.[44]
3. The DEIS assumes that the impacts of the proposed project to average stream water temperatures during the winter will be negligible or beneficial with no supporting evidence. We recommend that the EIS include analysis to support or revise these conclusions.[45]
4. The Draft EFH Assessment asserts that ice and beaver effects on stream morphology would likely minimize potential effects of flow alteration on channel morphology (5.1.1.3 Water Flow, pg. 70). We recommend that the EIS include additional information to support this conclusion.
5. We recommend that Section 3.24.5 of the DEIS be revised to consider how future changes in the regional climate may affect fish populations. We recommend that the EIS analyze long-term management under expected future climate scenarios, particularly in terms of water treatment and management and salmon populations. As discussed earlier, a key feature of salmon populations in the Bristol Bay watershed is their genetic diversity (i.e., the portfolio effect), which serves as an overall buffer for the entire population. Different sub-populations may be more productive in different years, which affords the entire population stability under variable

[44] Brannon 1987, Beacham and Murray 1990, Hendry et al. 1998, Quinn 2005, Healey 2011, and Martins et al. 2012.
[45] For example, Sparks 2018.

conditions year-to-year. If this variability increases over time due to changes in temperature and precipitation patterns, this portfolio effect becomes increasingly important in providing the genetic diversity to potentially allow for adaptation; thus, impacting or destroying genetically diverse sub-populations may have a larger effect on the overall population than expected under future climatic conditions.

Nutrient Inputs: The discussion of stream productivity (Section 4.24.2.4) includes unsupported conclusions regarding the importance of marine-derived nutrients, stating "[a]s shown in the baseline data above, marine-derived nutrients do not appear to influence the nutrient availability in the Koktuli or uppermost reaches of the Upper Talarik watersheds in the project area" (pg. 4.24-17). It is not clear what baseline data are referred to in this statement. Further, baseline water quality data are not relevant to supporting such conclusions, as it is likely that marine-derived nutrients in these relatively low-nutrient systems would get taken up quickly by biota rather than remain in the water column. Consideration of whether biotic production differs between anadromous and non-anadromous streams would be of more value in determining the influence of marine-derived nutrients. To evaluate the contribution of marine-derived nutrients to stream productivity, we recommend that the EIS evaluate changes to marine-derived nutrient inputs from the pre-existing condition and the consequences of these changes for stream productivity at multiple trophic levels or explain why its existing analysis of stream productivity is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

The DEIS includes almost no analyses of direct losses of autochthonous and allochthonous inputs from upstream reaches lost and/or disconnected from wetland and other riparian habitats, as well as the incremental reductions in those inputs in downstream segments throughout the stream reaches. We recommend that the EIS analyze these losses of autochthonous and allochthonous inputs and their effects on system-wide primary, secondary, and tertiary production that support fish populations or explain why the existing analysis of these inputs is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

The DEIS similarly includes almost no analyses to address invertebrate transport and production. Invertebrates are a significant source of food for fish. Macroinvertebrate and periphyton data are very spatially and temporally limited in the mine site area, limiting the utility of generalizations about stream productivity. No data on macroinvertebrate exports from headwater streams are presented in the DEIS, despite numerous studies showing these exports can be important in Alaska streams.[46] We understand that a macroinvertebrate technical working group was convened, and limited data on macroinvertebrates were collected in the mine site area and along the northern transportation corridor as part of the environmental baseline for the project; however, the DEIS does not include this information. We recommend that the EIS analyze invertebrate transport and production, using available site-specific data and where necessary supplementing these data with additional sampling and information. Alternatively, we recommend that the Corps explain why its existing analysis of invertebrate exports is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

[46] For example, Wipfli and Gregovich 2002, Wipfli et al. 2007.

Modeling of Impacts to Aquatic Resources: The DEIS identifies significant uncertainty in the groundwater model, which affects the water balance and streamflow alteration predictions[47] (see Groundwater and Surface Water Hydrology comments above). No accuracy or sensitivity analysis was performed on the water quality modeling and predictions (see Water Quality section, above), or the physical habitat simulation modeling (see comments below). The DEIS does not include information about how the uncertainties in modeled predictions (e.g., predictions in flow alterations and sources of water and contaminant contributions) affect predicted impacts to fish and fish habitat. We recommend that the EIS discuss the validity and accuracy of model outputs when assessing project impacts to fish and fish habitat.

The Draft EFH Assessment discloses that a hybrid simulation analysis model (HABSYN) was used to synthesize habitat-flow relationships. According to the document, HABSYN is meant to account for predicted stream flow reductions and treated surplus water discharges from the mine water treatment plants, and its predictions are based on physical habitat simulation system (PHABSIM) modeling at measured transects. PHABSIM forces/assumes a fish-habitat relationship based on water depth and velocity (discharge) alone. We also note that PHABSIM and its subcomponents (habitat suitability curves and wetted usable area) were identified by the Pebble Project Instream Flow Technical Working Group as being problematic and inappropriate for assessing fish habitat in the project area.[48] The DEIS and supporting documents have not established that there is a relationship between discharge and fish habitat selection, which is of particular import given that the impacted sub-watersheds of the proposed Pebble Project mine site are groundwater-driven systems. We recommend that the EIS fully explain the uncertainties and limitations of the PHABSIM and HABSYN models and describe how the limitations affect the analysis of fish and fish habitat impacts. Additional technical recommendations related to habitat modeling include:

1. PHABSIM and associated preliminary watershed model results presented in the Draft EFH Assessment (Table 5-3) indicate habitat losses in the NFK and SFK Rivers for some species and habitats (e.g., coho and Chinook salmon spawning). The DEIS asserts that there are habitat gains downstream (due to increase discharges), but these are modeled increases in discharge, and no analysis is provided to indicate that there will be resulting habitat increases. Table 5-3 also reports net gains in sockeye salmon. However, PHABSIM likely is not appropriate for capturing habitat for species that key into habitat factors, such as areas of groundwater upwelling (e.g., spawning sockeye), that are unrelated to water depth and discharges. We recommend additional analyses be conducted to support the results reported in EFH Assessment Table 5-3.
2. The Draft EFH Assessment discloses that wetted usable area will be used to identify available habitat; however, the information presented in Table 4.24-2 and Table 4.24-3 appears to be based on the assumption that increases in water depth and/or velocity equate to additional spawning and/or rearing habitat (see discussion above regarding limitations of PHABSIM modeling). While the tables may lead to the conclusion that there will be an increase in habitat due to discharges, discharges also may result in negative impacts (e.g., redd scouring). We recommend

[47] Monthly average discharges were chosen as inputs in the streamflow model, which do not represent the range of flows that occurs each month or extreme precipitation events, both of which affect stream ecology. Calibration of the stream flow model indicated that cumulative flows were overpredicted during the first two years of the calibration period and underpredicted during the remaining three years. In some cases, measured and calculated flows differed by more than 20 percent. The model may also not be able to predict the lowest flows (RFI 104).

[48] ISF TWG meeting minutes 2010.

that the Corps evaluate potential impacts of water discharges on all relevant habitat factors, rather than focusing only on increases in water depth and/or velocity.

3. Baseline documents indicate and the Draft EFH Assessment discloses that habitat suitability curves were developed from PHABSIM modeling efforts, but the DEIS does not discuss habitat suitability curves or the appropriateness of their use. We recommend that the EIS include additional data and analyses to demonstrate the validity of this approach.

The DEIS does not include analysis of how the predictive models work together to analyze and quantify the cumulative impacts of potential changes in streamflow or water quality, and the subsequent consequences for fish and fish habitat (e.g., how flow modeling integrates with downstream water temperature modeling to demonstrate lateral and longitudinal changes in the heterogeneity and complexity of side-channel spawning habitat or beaver pond rearing habitat, or how impacts from surface and groundwater flow alterations and corresponding changes in downstream water quality affect distribution and production of benthic macroinvertebrates). We recommend that the EIS analyze and discuss model integration to explain how individual predictive models are combined to assess and quantify project impacts and to identify what consequential outputs mean for fish and fish habitat. Alternatively, the Corps should explain why its existing analysis is sufficient, in light of the significance and complexity of the discharge activities associated with this project.

COMMERCIAL AND RECREATIONAL FISHERIES

The DEIS does not fully describe the value of the Bristol Bay fisheries, which includes the largest sockeye salmon fishery in the world, or the Pebble Project's and project alternatives potential impacts to these fisheries. As a result, many of the conclusions in the DEIS regarding the value of the fisheries lack context to support stated conclusions. Analysis of impacts to commercial fishing "relies on Section 4.24, Fish Values, which estimates that Alternative 1 would not have measurable effects on the number of adult salmon returning to the Kvichak and Nushagak river systems as a result of project operations, due to the limited lineal footage of upper Koktuli River fish habitat affected by placement" (pg. 4.6-5). The DEIS states that the magnitude, extent, duration, and likelihood of project effects of Alternatives 2 and 3 on commercial fishing would be expected to be the same as Alternative 1, with the exception of increased fishing pressure on freshwater waterbodies under Alternative 3 due to the presence of a continuous road providing access to these waterbodies along the north side of Lake Iliamna. As described in our following comments, we recommend that the EIS fully analyze identified issues and utilize the available scientific literature to support conclusions regarding the value of these fisheries.

The analysis of impacts to commercial and recreational fisheries examines expenditures and number of trips for recreational fisheries as well as revenues for commercial fisheries, which are common features of a typical economic impact analysis. However, the EIS does not appear to acknowledge the existence of additional sources of value that should be considered in the analysis. For example, the assessment places a value of zero on passive use, existence, and bequest values associated with these fisheries. Further, when there are potential conflicts the assessment generally assumes that fishermen (commercial and recreational) will alter their behavior, with little analysis of the real costs of that avoidance behavior. We recommend that the EIS identify and consider additional economic values and acknowledge that those values are likely to be positive. We further recommend that the assessment include welfare theoretic values of willingness-to-pay or consumer surplus for a day of recreational fishing in addition to the cost or expenditure data presented in the assessment.

1. In the description of the Cook Inlet gillnet fishery, the DEIS includes the following evaluation: "… the potential for conflict is low because of the depth of the pipeline on the sea floor, and the specifications of drift gillnet gear" (pg. 3.6-19). No evaluation of potential conflict is made for any of the groundfish species or for shellfish and other species. Regarding Cook Inlet groundfish, the DEIS states (pg. 3.6-22) that harvesters have greater flexibility to avoid fixed assets such as pipelines and undersea cables due to the size of the federal management areas. We recommend that the EIS clarify whether this is an estimate or an evaluation of how these fishermen may change their behavior as a result of the proposed pipeline. We recommend that the EIS include analysis of potential pipeline conflicts for all commercial fisheries in Cook Inlet.

2. We recommend that a change in recreational fishing effort as a function of perceived loss of quality in the fishery be considered as one of the potential impacts of the proposed mine and its construction. Examples exist of a recent discussion of these types of losses after the Gulf of Mexico oil spill (English et al. 2019; Glasgow et al. 2019).

3. The DEIS does not fully analyze impacts to recreational fishing on the Kenai Peninsula. While acknowledging that a new compressor station as well as the eastern terminus of the proposed natural gas pipeline are proposed to be constructed in this area, the document states that: "The facility would not be expected to affect angling in the area; thus, Area P (Kenai Peninsula) is not discussed in further detail in this section" (pg. 3.6-27, footnote to Figure 3.6-15). Given that the project will result in on-the-ground impacts associated with construction and operation of this infrastructure, we recommend that the EIS include additional analysis to support the conclusion that the expected effect to recreational angling in Area P is zero.

4. Regarding effects on salmon populations, the DEIS states "In terms of the magnitude of impacts, construction and operation of the project would not be expected to have measurable effects on the number of adult salmon returning to the area. In terms of the extent of impacts, commercial harvesters may have to change fishing patterns based on the proximity of fishing to port operations, or could experience losses if port operations affected salmon returns" (pg. 4.6-6). We recommend that the EIS define the distinction between "magnitude" and "extent" of impacts in this context and resolve apparent conflicts between the two statements above in terms of acknowledging potential impacts to salmon returns and populations.

5. The DEIS states that there would be "no measurable impacts on sport fish" (pg. 4.9-9). However, potential impacts are described elsewhere in Section 4.6. For example, the DEIS acknowledges the potential for there to be economic impacts borne by recreational fishermen and affiliated guides and lodges, stating that "Affected operators could substitute fishing on different streams, albeit at potentially higher costs to themselves and their consumers" (pg. 4.6-8) and states that "the pipeline itself could disturb traditional halibut concentrations…" (pg. 4.6-9). We recommend the impacts on sport fish be quantified in the EIS, and that statements regarding measurable impacts be revised as appropriate.

6. The DEIS states that "The extent of construction and operations of the projects would be to affect the quality of the fishing experience in the immediate vicinity of the project where project facilities are visible…" (pg. 4.6-9). Fishing in an area with an undisturbed watershed is likely a different perceived experience that fishing in an area with an active mine and its infrastructure, regardless of whether or not those facilities are directly visible. We recommend that the EIS

include analysis to support the assumption that impacts on the fishing experience would occur only where project-related changes are visible.

7. The DEIS states that "…revenues would shift between municipalities and companies but not necessarily change in total…" (pg. 4.6-9). We recommend that the EIS clarify what "not necessarily" means in this context, and that the EIS explain which municipalities are likely to be affected even if overall visitation to the region doesn't change.

Subsistence: Currently the assessment of Bristol Bay fish resources does not include subsistence values. The subsistence fishery is addressed in a separate chapter, which quantifies harvest levels of subsistence fish resources but does not quantify the economic value of the subsistence fisheries. Because the DEIS currently considers the commercial and recreational fisheries independently of subsistence values, the DEIS presents an incomplete picture of the value of Bristol Bay fishery resources. We recommend that the subsistence fishery information be combined with the commercial and recreational aspects to provide a comprehensive assessment of the Bristol Bay fishery resource values.

Weathervane Scallops, Roe Herring, and Salmon: The DEIS discloses that the harvest and long-term productivity of the Kamishak Bay weathervane scallop fishery could be affected by the route of the proposed natural gas pipeline (pg. 4-6.2 and pg. 4.6-6), and that the construction and presence of the pipeline may delay or negate future openings of the fishery due to sea bed floor disturbance. The DEIS does not, however, appear to fully analyze the extent, magnitude, or duration of impacts. We recommend that the EIS include an assessment of the weathervane scallop fishery, including the two weathervane scallop beds that are in the path of the pipeline, and the impacts of the pipeline on this fishery.

The DEIS states that in terms of the magnitude of impacts, construction and operation of the Amakdedori port would not be expected to have measurable effects on the number of adult salmonids returning to the Chenik sub-district of Kamishak Bay fishing district (pg. 4.6-6). This is also the same area as the historic Pacific herring sac roe fishery. The DEIS includes no impact assessment of either of these fisheries. The DEIS discloses that the Pacific herring fishery in Kamishak Bay could experience direct or cumulative effects, but no analyses are presented. We recommend the EIS include analyses of these fisheries and the extent, duration, and magnitude of environmental consequences to these fisheries from project impacts and alternatives.

Value of the Fisheries: The DEIS lacks many specifics of the value of the Bristol Bay, Nushagak and Kvichak watershed fisheries. We recommend that the EIS utilize information from the current ADFG Annual Management Report[49] as one of the single best sources of summary information for the Bristol Bay fisheries, including the reporting of last year's record setting Sockeye Salmon returns from the Nushagak District. The DEIS further indicates that Bristol Bay salmon fisheries "suffer" from a lack of value, recognition, and branding. This likely underestimates the known and well-documented value of the Bristol Bay salmon fisheries. Bristol Bay Sockeye Salmon are branded and advertised on the global market.[50,51] We recommend that the EIS either include the best science and information available to support its conclusion or revise the conclusion accordingly. Additional specific comments are below:

[49] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-11.pdf
[50] https://bristolbaysockeye.org/
[51] https://www.bbrsda.com/history

1. The DEIS indicates that the Nushagak River does not particularly stand out for the average size of its sockeye salmon run, (pg. 3.6-4) but does not include that the Nushagak River provides an annual average return of 2.3 million sockeye salmon. Further, the 2018 Nushagak District sockeye salmon harvest of 24.1 million fish was the largest single Bristol Bay district harvest on record.[52] We recommend that the EIS text be revised accordingly.

2. We recommend that the EIS also include that the 2018 Bristol Bay preliminary ex-vessel value of $281 million of all salmon species ranks first in the history of the fishery and was 242 percent above the 20-year average of $116 million. It was 39 percent higher than the $202 million ex-vessel value of the 1990 harvest, which ranks second. The 43.5 million harvest of all species was the second largest in the history of the fishery, after the 45.4 million fish harvest in 1995. The sockeye salmon harvest of 41.3 million ranks second after the 44.2 million fish harvest, also in 1995.[53]

3. We recommend that the EIS include an assessment of the differing run timing of salmon species returning to each district. Differences in run timing are an important aspect of the Bristol Bay salmon portfolio, ecologically and economically. For example, during 2018 the Naknek-Kvichak, Egegik, and Ugashik districts (east side) observed the latest run timing on record, and, because of the disparity in run timing between the Nushagak and the east side districts, the processing sector was able to keep pace with the run. This suggests that, in addition to the variability in abundance of returns, variability in timing of the returns is key to sustaining the economic stability of the processing sector. We recommend that this chapter include consideration of the salmon portfolio effect that accounts for the resiliency of Bristol Bay salmon fisheries in the region.[54]

4. The Nushagak–Mulchatna rivers drainage produces the largest runs of Coho Salmon in Bristol Bay. Within the drainage, there are 4 areas of concentrated recreational effort: the lower 15 miles of the Nushagak River near the village of Portage Creek; the middle section of the Nushagak River in the vicinity of the village of Ekwok; the section of the Mulchatna River between the Stuyahok and Koktuli rivers; and, the upper Nushagak River from the outlet of Nuyakuk River upstream to the outlet of the King Salmon River. Of the areas mentioned above, the lower portion of the Nushagak River and the fishery in the immediate vicinity of the Nuyakuk River outlet have long been the most significant.[55] We recommend the EIS include this information relevant to the value of the fisheries that will be impacted by the project.

5. We recommend that the EIS include all sport fisheries in the project area, including the Sockeye Salmon and Chinook Salmon recreational fisheries or the Rainbow Trout special management areas with in the Nushagak and Kvichak watersheds, including the upper Nushagak, Kvichak River and upper Talarik Creek. Additional information on sport fisheries in the project area can be found on the ADFG website.[56] We recommend this important fishery information be included and impacts analyzed in the EIS.

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[52] http://www.adfg.alaska.gov/static/applications/dcfnewsrelease/989536277.pdf
[53] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-11.pdf
[54] https://www.adfg.alaska.gov/index.cfm?adfg=fishingSportFishingInforuntiming.main&chart=runbbk
[55] https://www.arlis.org/docs/vol1/K/934855450.pdf
[56] https://www.adfg.alaska.gov/static/regulations/regprocess/fisheriesboard/pdfs/2018-2019/bb/FMR18-27.pdf

6. We recommend that the EIS include information on the aesthetic value of the Bristol Bay salmon fisheries or the Upper and Lower Cook Inlet fisheries.

7. Table 3.6-2 Bristol Bay Economic Contribution, 2010 (pg. 3.6-5) cites a 2013 report by Knapp, Guiettabi and Goldsmith. There is a more recent (2018) report on the benefits and economics of Bristol Bay salmon available,[57] and we recommend that this more recent information be factored into the analysis.

Fisheries Management Regime: The DEIS does not fully characterize the historical and ongoing research and management efforts that are in place to help ensure the sustainability of the Bristol Bay, Nushagak, and Kvichak watershed salmon fisheries. We recommend the EIS include discussion of Bristol Bay and Cook Inlet species management plans and the management regime of the ADFG in the EIS. This is important information to include given the financial investment made annually by the State of Alaska to sustain Bristol Bay fisheries through management efforts. We recommend that the EIS include the ADFG management plans currently in place to help ensure the sustainability of the fisheries, including the *Nushagak-Mulchatna King Salmon Management Plan,*[58] The Bristol Bay Five Year Strategic Plan: 2018-2023,[59] the *Nushagak River Coho Salmon Management Plan,*[60] and the sockeye salmon management plan. All include actions and restrictions that should be taken if the in-river runs fall short of management goals. We recommend that the EIS include a comprehensive analysis of the current Bristol Bay fisheries management regime and the potential for regime shifts as a consequence of project impacts to commercial and recreational fisheries.

Additional information that we recommend incorporating into the EIS analysis, including examples of the resources committed to Bristol Bay salmon fisheries due to their well-recognized value and importance to the local, national and international markets, includes:

1. The Bristol Bay genetic baseline that ADFG has built and tested over the past 17 years, found on page 3 of the 2017 Bristol Bay Area Annual Management Report.[61]
2. The Bristol Bay Research Institute sited at Port Moller.
3. The Bristol Bay Regional Seafood Association 2018-2023 Strategic Plan.[62]
4. The work and research of University of Washington's Alaska Salmon Program provides a wealth of information on regional fish populations with many relevant peer-reviewed journal articles that could be referenced to characterize the fish ecology of the region.[63]

Visualization Tools: We offer the following recommendations regarding figures provided for Section 3.6, in order to improve the understanding of Commercial and Recreational Fisheries in the project area:

1. We recommend that maps of commercial and recreational fisheries (e.g., Figure 3.6-10 Upper Cook Inlet Drift Net Management Areas, Figure 3.6-11 Cook Inlet Management Area Groundfish Areas and District Boundaries, and Figure 3.6-13, Cook Inlet Management Area and Shellfish Districts) be overlaid with project components, such as the proposed pipeline. Visualization would assist decisionmakers and the public in understanding the proximity of project components to fisheries.

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[57] http://www.pebblescience.org/pdfs/EconomicBenefitsofBristolBaySalmon-July-2018.pdf
[58] 5 AAC 06.361
[59] https://www.bbrsda.com/strategic-plan/
[60] 5 AAC 06.368
[61] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-11.pdf
[62] https://www.bbrsda.com/strategic-plan/
[63] https://sites.uw.edu/aksalmon/

2. We recommend including the percentage of active permits to permits owned above each bar in Figure 3.6-6 Distribution of Quartiles in the Drift Net Fishery by Area of Residence, to aid understanding of how Figure 3.6-6 relates to Table 3.6-4.

3. Table 3.6-9 & Table 3.6-10 present average angling days and statewide harvest survey information for waterbodies in the project area. We recommend including a map showing the location of these waterbodies/rivers relative to the proposed mine site and proposed infrastructure.

GEOHAZARDS

Key issues associated with geohazards pertain to recommendations that the EIS include additional detail regarding embankment designs and seismic stability to support the DEIS conclusions related to the safety and stability of tailings storage facility and water management pond embankments. Accidents or failures associated with the embankments could have significant adverse impacts on ecologically important streams, wetlands, lakes, and ponds and the fishery areas they support. Our recommendations regarding these key issues are discussed below. Additional comments to improve the geohazards analysis are provided in the following our key comments.

Embankment Designs and Seismic Stability

Conceptual Level of Design to Evaluate Impacts: The DEIS (section 4.15 and Appendix K4.15) describes the tailings and water management dam designs as conceptual and therefore dam design features and the stability analysis are based on many assumptions. Given that stability of tailings was one of the significant issues arising from scoping, we recommend that that design of the tailings and water management dams be advanced beyond the conceptual design stage to at least a preliminary design level so that the EIS analysis is based on information more reflective of what would be constructed, with fewer assumptions and uncertainties. Other recent mining EISs developed by the Corps have included more than conceptual design information (e.g., Donlin and Haile) and we recommend that additional information also be analyzed and included for the Pebble Project. Alternately, we recommend that the EIS further explain why the approach using conceptual level designs is sufficient and how that approach impacts the accuracy of the impact conclusions.

Water and Seepage Management Associated with Embankments: The DEIS states that control of water is an important consideration in achieving a stable tailings deposit and embankment. However, the DEIS does not provide details on: 1) the specific freeboard allowance (feet) for the pyritic and bulk TSF embankments and IDF (see also our comments on surface water hydrology); 2) whether liners "and/or" core/filter/transition zones would be used for the non-flow through TSF embankments (see Table K4.15-1); 3) grout curtain depth and extent in comparison to location-specific bedrock characteristics to demonstrate that it would contain seepage flows; and 4) the design and spacing of basin and embankment underdrains to maintain a reduced phreatic surface. Since water control is important, we recommend that these details be provided in the EIS along with a preliminary design of tailings dams and seepage management systems to support EIS assumptions related to the effectiveness of water control for both seepage collection and stability.

Core Zone Material Types and Quantities: Appendix K4.15 indicates that sufficient quantities of low permeability materials for the bulk TSF main embankment filter and transition zones may not be available on site, so alternatives could be used. We recommend that material quantities be determined,

as was done for other mine site components, so that the need for additional quarries (which would impact the fill used and/or project footprint) is determined and explained in the EIS analysis. If alternatives are used that involve off-site materials this could impact the amount of transportation to the site during construction. We recommend that the EIS evaluate and explain how much material is needed, where it would come from, and the environmental impacts associated with obtaining and transporting it to the mine site.

Static Stability Analysis: Static stability was modeled and predicted for several of the TSF embankments, the WMPs, and the Bulk TSF SCP. Although not described as such in the main text of the DEIS (Section 4.15.2.1), the reference documents supporting the stability analysis state that it was a "preliminary static stability analysis" based on a "simplified concept" and that geotechnical and hydrogeologic data collection is ongoing to confirm assumptions in the preliminary stability analysis. Reference documents also state that embankment designs and stability analysis will be updated accordingly to reflect actual foundation conditions (RFI-008). We recommend completion of the geotechnical and hydrogeologic programs and revision of the stability analysis in the EIS to reflect further developed or actual foundation conditions. We understand that this would be required for ADSP permitting, but we believe that using actual conditions is consistent with ensuring a fair evaluation of potential impacts and risks. This is an important issue since a specific weak foundation condition was a contributing cause of the Mt. Polley TSF breach (Morgenstern et al. 2015).

In addition, as with any model, we recommend that sensitivity and uncertainty be discussed in the EIS so that the accuracy of the static stability model predictions can be assessed. This is particularly important given the conceptual nature of the dam designs and preliminary nature of the stability analysis.

Seismic Hazard Analysis: The DEIS provides a probabilistic and deterministic seismic hazard analysis, however aspects of the analysis in the DEIS are not based on current best practices and data. The DEIS and RFI 008c indicates that the seismic analyses will later be updated to incorporate: 1) current best practices, since the seismic analysis is based on a 2013 Knight Piésold report; 2) New Generation Attenuation (NGA) equations, since the DEIS seismic hazard analysis is based on 2008 NGA equations and revised equations were published in 2014; and, 3) updated United States Geological Survey (USGS) ground motion data. We recommend that the seismic hazard analysis in the EIS be updated to reflect best practices and current information. Alternatively, we recommend that the EIS explain why the approach (which is not based on best practices) is sufficient and explain the level of uncertainty associated with the seismic hazard analysis.

Pseudo-Static Deformation Analyses and Seismic Safety: The DEIS does not fully characterize the stability and performance of the TSF and main WMP embankments in response to a seismic event (earthquake). Pseudo-static deformation analyses are important to determine the embankment safety factors under seismic loading and to evaluate the stability and performance of an embankment during a seismic event. There was no deformation analysis conducted for the pyritic TSF embankment and the Main Water Management Pond embankment. In regard to the bulk TSF embankment, the DEIS relies on pseudo-static deformation analysis from an earlier design of the TSF main embankment (Appendix K4.15) to assess bulk TSF embankment seismic stability and deformation during earthquake loading conditions and does not fully describe whether the deformation analysis on the earlier design is representative of earthquake-induced stability changes and dam deformation that could occur based on the current dam design.

The TSF and Main WMP embankments are significant structures that range in height up to 545 feet and with combined lengths of 7.2 miles (for the TSF dams) and 3.6 miles (for the WMP dams). We recommend that pseudo-static deformation analysis be developed for the current bulk TSF embankments based on the current project plan and for the pyritic TSF and WMP embankments and that safety factors under seismic conditions and the impacts to these embankments in the event of a range of earthquake scenarios be included. If this analysis is not conducted, then we recommend that lack of a representative pseudo-static deformation analysis for the bulk TSF and lack of any pseudo-static deformation analysis for the pyritic TSF and Main WMP embankments be identified in the EIS as a data gap that affects analysis of how these dams would be impacted by an earthquake.

Additional Geohazards Analysis Comments and Recommendations

Following are additional comments and recommendations related to the geohazards analysis.

Foundation Conditions Under the WMPs: The DEIS (Appendix K4.15) mentions weak foundation conditions under the open pit WMP and main WMP and assumes that any potential foundation conditions (glacial clay layers) would be mitigated during design and construction after the collection of additional geotechnical information. We recommend that further detail, including mapping, be provided in the EIS that identifies the areas of weak foundation conditions and that PLPs construction and design documents be updated to identify these conditions and describe how these conditions will be managed. This level of information is important to assess the effectiveness of foundation condition mitigation.

State of Alaska Dam Safety Guidance: The DEIS refers to the Alaska Dam Safety Program (ADSP) guidance (ADNR 2017a) and relies on this guidance to conclude that the dams associated with the TSFs and WMPs will be stable and safe. The ADSP guidance is stamped "draft revision" and the guidance itself contains recommendations (as opposed to requirements) and notes that that dam safety statutes at AS 46.17 and 11 AAC 93 are the legal governance for the ADSP. The ADSP guidance also notes that compliance wth the ADSP "is intended to establish a minimum standard of care; however, additional effort by the dam owner may be required to fully understand and manage the associated risks and liabilities of owning a dam." We recommend that the evaluation of geohazards and dam stability in this section consider the legal requirements as well as the draft guidance. Since the ADSP guidance states that it is the minimum standard of care, we recommend that this section of the DEIS further describe how the specific embankment criteria selected (OBE, MDE, Safety Factors, slopes) are appropriate and conservative for the specific embankments and specific conditions at the site.

AIR QUALITY

The proposed project includes many potential sources of mine pollutant emissions, including from the operation of heavy machinery and equipment, other mobile sources (e.g., vehicles, ships, aircraft), stationary sources (e.g., power plant), and fugitive dust. Key issues include particulate matter impacts from the mine site, which are likely underpredicted in the EIS based on the modeling parameters used, as well as deficiencies in the air quality modeling assessment for the port facilities which, if corrected, may result in potential exceedances of the NAAQS for 1-hour or annual NO_2. Our recommendations regarding these key issues are discussed below. Additional comments and recommendations for improvement to the air quality analysis are provided following the key comments.

Air Quality Modeling

Mine Site Ambient Air Boundary: Air impacts based on dispersion modeling of the mine site are reported only at receptors outside of the ambient air boundary, as those are areas to which the public would have access. The ambient air boundary appears to extend far from the mine operations area, especially on the southeast side where most of the maximum air impacts occur. It is therefore critical to ensure that the correct ambient air boundary has been modeled, so that potential air quality impacts may be reported accurately. According to Appendix K4.20, the ambient air boundary used in the modeling is based on a safety zone that "would be established to ensure that the public would not be exposed to work site safety risks." We were unable to locate additional information regarding the establishment of this safety zone, including the rationale for determining its extent or the means through which it will be enforced. We recommend that this information be added to the EIS as part of the description of the proposed action. Specifically, additional information should be attached or referenced that provides the details regarding the safety zone and what steps (fencing, posting, patrols, etc.) PLP will take to preclude public access to these areas and confirmation that the land within the boundary is under the full control of PLP. While the State of Alaska will determine whether the ambient air boundary is properly established during the air permitting of the project, the Corps should consider including this information in the EIS, in order to accurately and adequately assess impacts.

Modeling of Mine Site Fugitive Dust Impacts: The modeling parameters used to simulate emissions from the mine pit appear to have resulted in an underprediction of particulate matter emissions from the pit. Modeling for the DEIS has been conducted using AERMOD's OPENPIT algorithm to simulate emissions from the mine pit. Based on the parameters provided in Table 4 of Appendix A, the effective depth of the pit calculated by AERMOD is 580 meters. Given a final central pit depth of 700 meters, the average effective depth of 580 meters represents conditions near the end of the life of the mine. In addition, the release height of the emissions is only 5.0 meters, which effectively results in the release of pollutants at a height 575 meters below the lid of the parameterized pit. These parameters likely result in an underprediction of particulate matter emission from the pit, especially during the early years of the project where the average pit depth is much less than the effective 580 meters depth simulated. We recommend using a more conservative estimate based on pit dimensions nearer to the beginning or middle of the life of the mine, where pit depth is less. Also, given that the pit shape is spherical instead of a box (as assumed in the OPENPIT algorithm), we recommend using an average release height that is more representative of the average height of emissions across a spherical pit, rather than the current assigned 5-meter release height that effectively results in emissions released at the bottom of the center of the pit.

Air Impacts at Amakdedori Port: The modeling analysis of potential air quality impacts of operations at the Amakdedori port was conducted using screening meteorology and a conservative conversion factor to estimate annual emissions. The screening meteorology approach likely results in a significant overprediction of results when emissions are properly simulated. In addition, the modeling assumed 8,760 hours per year use of the emergency engines which is highly conservative. On the other hand, only stationary unit emissions were modeled, despite the fact that the mobile emissions associated with the facility are much greater. Further, emissions from the hoteling ships don't appear to have been included in the analysis. As a result, it is possible that air quality impacts would be substantially higher than what was modeled. We recommend that the modeling analysis be revised provide an accurate estimate of air impacts at the site and support conclusions made in the EIS.

The air quality modeling for Amakdedori port also only addresses the annual NO_2 standard, based on a determination that this is the only modeling that would be required to obtain a minor source permit to construct and operate a stationary source at the port. However, the EIS should evaluate the potential for the proposed project to cause or contribute to a violation of any of the national ambient air quality standards (NAAQS). We recommend that the revised air quality modeling also include analysis of impacts to all NAAQS, including the 1-hour NO_2 standard. Such analysis is particularly important given that the annual NO_2 impacts are shown to be high at the fence line of the port, 90 percent of the NAAQS, indicating a potential for exceedances of the 1-hour standard. Although analysis of 1-hour NO_2 may be exempt from the modeling analysis of a minor-source permit application under state law at 18 AAC 50.540(l), the 1-hour NO_2 impacts are evaluated internally by ADEC. Regardless, the requirements of the State of Alaska's minor-source permit application process are not relevant in the context of NEPA review of ambient air quality impacts. If any exceedances of the 1-hour NO_2 AAAQS are predicted, we recommend that mitigation be evaluated in the EIS.

Air Quality Impacts of Alternatives and Variants

An air quality modeling assessment was performed only for Alternative 1. The DEIS assumes that Alternatives 2 and 3, as well as variants to all alternatives, are similar to Alternative 1 in terms of the air quality impacts. While this assumption may be accurate for the mine site, there are many differences in the proposed transportation corridor, port site, and natural gas pipeline, in terms of both emission rates and locations, which are not considered in the modeling assessment performed. We recommend that the EIS include additional assessment of the potential air quality impacts of Alternatives 2 and 3, and of the variants.

No air quality analysis was conducted for the Diamond Port facility as part of Alternative 2, and the DEIS assumes that the Alternative 1 Amakdedori Port air quality analysis is sufficient to quantify impacts from any of the port alternatives. However, given differences in land-use and terrain between the two sites, we anticipate that there are differences in meteorological conditions that could have a large influence on the maximum air quality impacts. The Diamond Port is also adjacent to much higher and more complex terrain, where plumes could more easily impact the surface. This is significant since the Alternative 1 Amakdedori Port modeling showed NO_2 impacts approaching the annual NAAQS, in addition to the model deficiencies described in the above comment. These issues, if corrected, may result in potential exceedances of the National Ambient Air Quality Standards for 1-hour or annual NO_2. We recommend modeling the Diamond Port facility using the most representative of the Pebble meteorological datasets, as there are three Prevention of Significant Degradation (PSD) quality datasets collected for this project within five miles of the site. We further recommend that this modeling account for related project emissions and include analysis of relevant NAAQS and averaging times. Alternatives 2 and 3 include dredging and recommend that emissions from dredging operations be included in the air quality model. Given the lack of representative meteorological data for the Amakdedori Port area and the more complex terrain at the Diamond Port site, we recommend that the Corps consider whether the Diamond Port modeling results could be used as a more representative and conservative estimate of port impacts for all Alternatives.

Other differences between Alternatives 2 and 3, and the information in Alternative 1 that was used in the air quality analysis, do not appear to be considered in the analysis. For example, Table 2-2 lists the differences in road length between Alternatives 1, 2, and 3. Similarly, there are differences in the length of ferry trips. We recommend that the air quality analysis for Alternatives 2 and 3 address how the change in road miles traveled for concentrate trucks and other vehicles, as well as the differences in

ferry miles traveled, would affect air pollutant emissions and impacts to air quality. In addition, while differences in mileage are discussed, there is no discussion about changes in elevation that different routes might require. An alternate truck route with larger elevation changes could result in greater emissions of criteria pollutants due to the engines working harder. We recommend that these air quality considerations be further analyzed in the EIS.

The DEIS air quality analysis also does not address the potential changes to air quality impacts from the "Summer-Only Ferry Operations" variant. This variant would group all the mobile source emissions caused by transferring concentrate from the mine site to the port into a six-month timeframe. Additionally, since no concentrate vehicles would travel from the site to the port during winter months and fugitive dust emissions from roads would be greater during summer months, the volume of fugitive dust generated by a summer-only variant would be greatly increased over the modeled year-round scenario. This would lead to higher atmospheric concentrations of the various combustion and fugitive emissions. We recommend that these impacts be evaluated in the EIS. Emissions would be concentrated during the growing season, and therefore would be likely to result in increased impacts to vegetation, which we recommend should also be evaluated in the EIS.

The DEIS describes maximum project air quality impacts in terms of a fraction of the standards but does not indicate what air pollutants resulted in the highest impacts nor the location of these impacts. We recommend that the EIS include a table listing the maximum design concentrations compared to the air quality standards, as well as discuss what pollutants resulted in the maximum impact and where these impacts were located. In addition, the text of the DEIS repeatedly refers to the "average" NAAQS value. However, it is not the average value that is of importance, it is the Design Value (DV), which is compared to the NAAQS. Please refer to the EPA's website[64] for information on appropriate NAAQS levels, averaging times, and form of the standard.

Additional Air Quality Analysis Recommendations

Emissions Inventories: Our review found potential errors in the emissions inventory report based on the use of incorrect emission factors. This includes use of outdated emission factors, use of stationary source emission factors to calculate emissions from mobile sources, use of an engine standard level rather than an emission factor, and failure to use the EPA's latest emissions model, MOtor Vehicle Emission Simulator (MOVES). MOVES is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants, greenhouse gases, and air toxics.[65] Because the EPA guidance was not followed in generating the emissions inventory, we do not recommend using this emission inventory in air quality modeling or to otherwise support conclusions regarding the potential air quality impacts of the Pebble Project. We recommend revising the inventory in accordance with published emissions guidance and using the updated emissions in the EIS and offer the following technical comments to assist in this effort. Alternatively, we recommend that the Corps explain the decisions made in selecting emission factors, and provide information to support the accuracy and reliability of the air quality modeling analysis based on the current emissions inventory.

We recommend addressing the following potential errors in the DEIS source document "RFI 007 Emissions Inventory Report" or providing a more-detailed explanation for their retention:

[64] https://www.epa.gov/criteria-air-pollutants/naaqs-table

[65] https://www.epa.gov/moves

1. RFI 007 Appendix A-2:
   a. We recommend that Table 3 (PDF pg. 56 of 509) use an emission factor for the mobile sources on this table, rather than the actual standard level listed in the regulations;
   b. We recommend that emission factors for vehicles be developed using the MOVES model rather than using AP-42 Volume II table. The AP-42 web page indicates that Volume II, regarding all mobile sources, is no longer maintained, as non-outdated EFs can be developed using the MOVES model;
   c. We recommend ensuring that emission factors from stationary sources are not used to calculate emissions from mobile sources. This recommendation also applies to Tables 3 through 7 (regarding criteria pollutants).
2. RFI 007 Appendix A-3: We recommend including additional documentation for calculations and confirming that break and tire wear have been included in the emissions calculations.
3. RFI 007 Appendix B: We recommend the same corrections in Appendix B as described above for Appendix A-2 regarding criteria pollutants from mobile sources and for Appendix A-3 regarding fugitive sources.
4. RFI 007 Appendix C-1. We recommend verifying that appropriate sources were used for emission factors.
5. RFI 007 Appendix C-2. We recommend the same corrections in Appendix C-2 as described above for Appendix A-2 regarding criteria pollutants from mobile sources and for Appendix A-3 regarding fugitive sources.

The emissions inventory tables in the DEIS include a column quantifying "Total HAPs." This is not a useful metric, as HAPs differ by toxicity, reactivity, etc., and we recommend that HAP emissions be broken out by type.

Background Concentrations: Background concentrations are an important element of an accurate analysis of impacts to ambient air quality, however, Appendix K4.20 does not include information on the background concentration analysis. We recommend that the EIS include the source of the background concentration values used in the air quality analysis. Background annual NO_2 is assumed to be 0 micrograms/cubic meter ($\mu g/m^3$) in the air quality modeling analysis conducted for Amakdedori Port. We recommend that the EIS provide supporting information that explains such a low background concentration, including addressing whether there are local representative measurements.

PSD Increment Impacts: While we support the inclusion of an impact comparison to PSD increments in the DEIS, there are several potential inaccuracies with the way PSD increments were calculated and disclosed. The DEIS states that a PSD increment consumption analysis is not required for temporary projects (less than 24 months), and therefore, the DEIS does not include a comparison to the particulate matter (PM) increment. However, we note that comparison of impacts to the PSD increments is done in NEPA analyses to gauge the significance of the impacts, recognizing the increment as a measure of significant deterioration, rather than to conduct a regulatory PSD increment analysis. We recommend that all modeled values be compared to the PSD increments, as a comparison measure of temporary degradation. In addition, the RFI 007 Emission Inventory finds that the mine site power generation facility will likely require a PSD permit for both PM10 and PM2.5, and therefore, a PSD increment consumption analysis may be required as part of the state permitting process. We therefore recommend the EIS identify the nearest Class I area and the distance of the Class I area from the project, as well as any minor source baseline dates that may have been established at this Class I area. If the baseline date has been set, we recommend the Corps consider analyzing the likelihood of significant Class I increment consumption from project operation emissions. If this is determined to be significant, 40 CFR Part 51,

Appendix W contains screening procedures to determine if a cumulative Class I increment consumption analysis is warranted.

We recommend that the DEIS text clarify that PSD regulations are not specific to major stationary sources, as is currently stated. Rather, the PSD increment is the allowed maximum increase in air pollutant concentration allowed in an airshed after a baseline date, and analysis of PSD increment consumption is required under New Source Review air permitting of major stationary sources in areas where the baseline dates have been set. Further, in reporting the results on the PSD increment comparison, the document states "Compliance with modeled … PSD Class II increments is demonstrated" (pg. 4.20-6). We recommend instead stating that the modeling demonstrates that the level of air quality deterioration is lower than the PSD increment, which can be used as a measure of significant deterioration for any given project.

Air Quality Related Values Impacts to Sensitive Areas: The DEIS discusses the potential for impacts to Air Quality Related Values (AQRVs) in Class I areas and concludes that, because the nearest Class I areas are "more than 62 miles from the source," negligible impacts are anticipated. The analysis described in Section K4.20 includes a visibility impacts screening method as well as a comparison to deposition critical loads for Denali National Park. We recommend that the EIS include additional analysis and disclosure of potential visibility and deposition impacts to Tuxedni Wilderness Area, which is the nearest Class I area and is "approximately 50 miles east-northeast of the mine site" according to the DEIS (pg. 3.20-6).

There are numerous other federally or state-managed areas within the potential impact area of the Pebble Project, as described in Section 3.5 of the DEIS. The nearest of these include: Katmai National Park and Preserve, Lake Clark National Park and Preserve, Alaska Maritime National Wildlife Refuge, McNeil River State Game Sanctuary, and the McNeil River State Game Refuge. We recommend that the AQRV analysis address the potential for any adverse impacts, including visibility or deposition impacts, to these protected areas. As an initial step in this analysis, we recommend that it would be appropriate to consult with the relevant land management agencies regarding whether the environment of the federal or state-managed area is considered to be sensitive as related to any AQRVs.

Hazardous Air Pollutants: In discussion of HAPS selected for the analysis, that ethylbenzene and xylene have been omitted from the list of HAPs. Because trucks and nonroad equipment use diesel fuel, we recommend considering all BTEX constituents in the analysis.

ENVIRONMENTAL JUSTICE

Environmental Justice is not among the primary issues summarized in the EPA's cover letter. However, based on our review, we are providing the following recommendations to improve identification and protection of vulnerable populations.

Identification of Vulnerable Populations

The DEIS cites the 1997 CEQ Environmental Justice Guidance under the National Environmental Policy Act (CEQ 1997b) to state that a minority community is "defined as a community with a majority (i.e., 50 percent or greater) minority population" (pg. 3.4-1). The DEIS does not currently acknowledge that the CEQ guidance also indicates that a minority population should be identified where "the minority population percentage of the affected area is meaningfully greater than the minority population

percentage in the general population or other appropriate unit of geographic analysis." The CEQ guidance provides ample flexibility to methodologically respond to local conditions and population patterns. Furthermore, the EPA Environmental Justice guidance (EPA 1998) states that "[a] factor that should be considered in assessing the presence of a minority community is that a minority group comprising a relatively small percentage of the total population surrounding the project may experience a disproportionately high and adverse effect. This can result due to the group's use of, or dependence on, potentially affected natural resources, or due to the group's daily or cumulative exposure to environmental pollutants as a result of their close proximity to the source." Additionally, the Federal Interagency Working Group on Environmental Justice[66] has stated that, "[to] sufficiently identify small concentrations (i.e., pockets) of minority populations, agencies may wish to supplement Census data with local demographic data. Local demographic data and information (including data provided by the community and Tribes) can improve an agency's decision-making process. Anecdotal data should be validated for accuracy whenever possible. Agencies should disclose, as appropriate, when anecdotal data has not been validated." (Federal Interagency Working Group on Environmental Justice 2016).

The EPA maintains that the exclusive use of the 50 percent threshold in the CEQ 1997b guidance could result in missing smaller communities, segments, or pockets of low income, minority, or vulnerable populations within larger community settings who might be impacted. For example, in Table 3.4-2, communities within the Kenai Peninsula Borough and Bristol Bay Borough are not identified as EJ communities. Therefore, there may be pockets of minority or low-income populations, or entire communities, that might disproportionately experience cumulative impacts, but these are not acknowledged in the DEIS. We recommend that the EIS provide the rationale for selecting the 50 percent threshold definition of minority community, and not another available methodology. In addition, we recommend that the environmental impact analysis in the EIS also include demographic and locational information on any minority and low-income populations living in communities not identified as EJ areas, due to not meeting the 50 percent threshold, and analyze disproportionate and cumulative impacts to those populations.

Analysis of Potential Environmental Justice Impacts

Potential Impacts to Children: Table 3.3-1 presents the Population Characteristics of Affected Communities. Notable in some of the affected communities are the high percentages of children, a vulnerable population in Environmental Justice terms. Research in recent years has revealed and highlighted the unique vulnerabilities and susceptibilities of children to environmental harms (Barros et al. 2018). Native Alaskan children sometimes experience environmental impacts disproportionately (Sarche and Spicer 2008). We recommend that the DEIS specifically address the short and long-term health and safety of children in the analyses of disproportionate impacts, cumulative effects, and socio-economics, especially in terms of nutritional dislocations and potential exposures environmental contaminants.

Socio-Economic Impacts of Mine Closure: Mine closure will result in loss of jobs and declining economic activity, which, based on the discussion in the DEIS, could potentially be followed by a decline in community infrastructure, with subsequent impacts on the health and welfare of community residents. The DEIS notes the boom and bust cycle that characterizes the Alaskan economy. Community development, sustainability, and revitalization are recognized as essential components of Environmental

[66] https://www.epa.gov/environmentaljustice/federal-interagency-working-group-environmental-justice-ej-iwg

Justice.[67] However, sustainable economic development can be seen as a model for mitigating the impacts of the bust of mine closure. While extractive industries can disrupt the resources and cultural patterns of economic activity, the lengthy time frame of mine operation and inflows of capital could provide the space for community-based planning efforts to build sustainable economies in the region (EPA 2013). We recommend that economic disruptions in these communities be undertaken delicately with the full participation and informed consent of the people most directly impacted. The Corps may choose to review any locally developed Economic Development Assessments/Plans specific to the communities of the Region. These plans would be an integral component to sustainable, community driven, economic development in the region. Finally, a Community Benefits Agreement or other formal instrument (such as a Memorandum of Understanding or Memorandum of Agreement) could be developed to ensure minimum levels of employment, improvements and enhancements to health facilities, joint planning and consultative opportunities and other elements related to the long-term, sustainable development of impacted communities. This could be in addition to, or an aspect of, the ANCSA village corporation agreements described in Table 5-2.

SUBSISTENCE

Subsistence is not among the primary issues summarized in the EPA's cover letter. However, given the importance of subsistence resources in the project area, we are providing the following recommendations to strengthen the analysis in the EIS.

Age of Subsistence Studies Cited in the EIS: The subsistence information presented in the DEIS is from studies that are almost all over a decade old, and many are based on data collected by the Alaska Department of Fish and Game (ADF&G) in 2004. These studies may show past harvest levels, but they cannot show potential recent changes in resource use due to shifts in animal populations or from ecosystem impacts of exploration activities. Without more recent studies, current consumption levels are uncertain, and it is therefore difficult to tell what the impacts of the mine on subsistence harvest levels will be. We recommend that the EIS incorporate any more recent data available and acknowledge the challenges that the older data present in assessing impacts of the Pebble Project on present harvest levels.

Impacts to Subsistence Practices and Patterns: The DEIS makes many statements that presume adaptation to changes in historical and current subsistence practices and patterns. For example, the DEIS states: "Adaptive strategies for the harvest of resources ***would likely maintain harvest levels for affected communities***, but potentially at the cost of additional time and money" (pg. 4.4-5, emphasis added); and "Subsistence users ***would likely adjust*** the seasonal round, resource use areas, and species composition of harvest resources to target resources that would be less affected by project activities" (pg. 4.4-7, emphasis added). We recommend that the EIS provide additional support for these and other similar statements regarding how likely the adaptation/adjustment is to occur or how effective it would be in maintaining subsistence harvest levels, including addressing the ability, capacity, or cultural willingness to access alternate areas and make dietary substitutions across all sectors of the population (e.g., different dietary needs of children and elderly). Underlying many of these assertions are what appear to be unsubstantiated behavioral assumptions about the value calculations and the resulting actions of individuals with regard to income from outside employment. By presuming adaptation, the EIS may be underestimating the potential impacts of the proposed Pebble Project. We recommend that the document

[67] https://www.epa.gov/environmentaljustice/resources-creating-healthy-sustainable-and-equitable-communities

state the underlying assumptions upon which the analysis, where present, is based, including citing evidence of such adjustments by individuals and communities in similar circumstances.

Replacements Costs: We recommend that the EIS include the total amount of traditional foods used by tribal communities, including the replacement costs for those foods. For example, mining activities may cause caribou to be less accessible if the caribou herd does not return to their traditional range. We recommend considering what it costs a family to replace that protein by shopping at a store. As acknowledged in the DEIS, grocery costs are very high in the region, and replacement of traditional foods could result in a tangible economic impact for communities that still rely on the traditional economy of hunting, trapping, and harvesting. We recommend that replacement costs from reduced subsistence harvest be analyzed in the EIS and included as a potential impact of the proposed Pebble Project.

Harvest Levels if the Mine is Permitted: We recommend that the EIS include a detailed plan for how subsistence harvest levels will be documented during Pebble Project construction and operations, so that potential impacts to subsistence can be monitored and adaptive management strategies can be implemented as needed to support sustainable levels of subsistence harvest.

Impacts of Increased Traveling Distance for Subsistence Harvesters: We recommend that the EIS analyze the potential impacts to harvesters' travel times and distances. With increased distance comes increased cost and risk. If mine activities cause harvesters to travel farther to hunt, this increases the resource commitment to engage in the traditional way of life, including increased fuel costs, increased wear and tear on vehicles, greater risks of accident and injury, and more challenging transportation logistics. In addition, we recommend that the EIS analyze whether the greater distances traveled for hunting may further limit the number of active harvesters, and thus reduce the amount of traditional foods available to the entire community and result in high replacement costs.

Access: The DEIS indicates that subsistence access could be increased by use of the roads and pipeline rights of way (ROW). For example, the DEIS states that "[t]he addition of a pipeline ROW would potentially create an overland route that could be used by Nondalton residents to access additional subsistence resources." In contrast to this statement, the project description describes the road as being "private." In order to support the conclusions in the document, we recommend that the EIS discuss the development of a detailed agreement between PLP and the affected communities to provide access to the transportation infrastructure. The EIS would be strengthened by providing the agreement itself. In the alternative, any language referencing increased subsistence access due to the ROW should be removed throughout the EIS. In addition, we recommend that the EIS confirm whether the complete boundary of the mine site safety zone has been considered when determining which areas would be restricted from subsistence access, rather than using the footprint of mine facilities.

Mapping: The DEIS shows the subsistence use areas by community, but to understand potential changes to the region, it would be helpful to have a map that shows overlapping subsistence harvest areas, so that areas of higher value because of their use by multiple communities could be more easily evaluated. We recommend including a map in the EIS that indicates: 1) Areas where all communities harvest; 2) Areas where some communities harvest; 3) Areas where few communities harvest; 4) Areas where one community harvests; and 5) Areas where no community harvests.

Seals: The DEIS does not fully describe the impact of ferry use on seal hunting. Seal is high in omega-3 essential fatty acids, which contribute to human health in a number of ways. These nutrients are difficult

to replace in the western diet, so disruption of seal habitat and reduced opportunities to harvest may have health implications. We recommend that additional information be included in the EIS to clarify the characteristics of the seal population in the lake and their habitat uses, so that the potential impacts of ferry use can be analyzed. We also recommend that the EIS quantify the potential impact of the Pebble Project on seal harvests.

Traveler Safety on Lake Iliamna: Changes to ice integrity from winter ferries and the impacts of these changes on traveler safety do not appear to be fully analyzed and considered in the DEIS. The DEIS mentioned that markings would be put out to alert travelers to the ferry lane, but does not state whether these markers will be effective for winter travel in dark or white out conditions. We recommend that the EIS further consider traveler safety during winter travel on Lake Iliamna.

SPILL RISK

Key issues associated with the spill risk analysis includes recommendations for improvement of the analysis of the environmental fate and behavior of spilled concentrate and tailings including consideration of the role of oxygen in aquatic environments, timing for release of mineral components, and reactivity in porewater. In addition, we recommend that a Bulk TSF failure scenario be developed and potential impacts be evaluated. Our recommendations regarding these key issues are discussed below. Additional detailed recommendations for improvement to the spill risk analysis are provided following the key issues.

Bulk Tailings Release Scenario

The release of tailings from the bulk TSF due to an embankment breach or failure was not evaluated in the EIS based on the conclusions of the EIS-phase Failure Mode Effects Analysis (FMEA) (Section 4.27.6.9). The FMEA indicated that it was based on an early stage conceptual level of embankment designs and did not assess the confidence level of the failure modes and effects as is typically done (AECOM 2018i and Robertson 2003). FMEA can be a valuable tool in identifying potential failure modes, effects, and mitigation. However, it is unclear how the FMEA was used to determine the TSF release scenarios as the FMEA contained limited rationale for how the likelihood of failure risks were determined and did not describe the confidence or uncertainty associated with the release scenarios. Given the conceptual stage of and many assumptions associated with the embankment design and the limited seismic analysis that was not conducted on the current bulk TSF dam design (see our Geohazards comments), we recommend that alternate scenarios, including a breach scenario, be considered. In addition, the FMEA is based on limited information since: 1) it utilizes conceptual embankment designs (as opposed to more advanced designs); 2) there is a lack of a seismic analysis; 3) specific design information on the seepage management systems, underdrain system, and the core and filter/transition zones is not provided; 4) the material sources are not identified; and, 5) it is assumed in the DEIS that embankment raises would be done proactively, however the Project Description and DEIS do not provide a schedule for these embankment raises in comparison to freeboard and tailings placement rates. In addition, due to underestimated open pit groundwater inflows there is significant uncertainty associated with the water balance and one of the adaptive management strategies discussed in the DEIS to maintain the water balance is to transport water to the bulk TSF (pg. 4.16-8). Implementing this strategy would result in mine operations that are different than the conceptual design.

The FMEA risk register identified a number of adverse factors that could occur during engineering, construction, and operations, and the DEIS assumes that they would all be overcome. Yet, a recent study

on tailings dam failures notes that the dominant cause of failures arises from deficiencies in engineering practice associated with the spectrum of activities embraced by design, construction, quality control, and quality assurance (Morgenstern 2018). Therefore, there is credible information highlighting that, even assuming that the tailings dam is adequately designed, dam failure could still happen due to weak engineering associated with construction and operations. We recommend that this possibility be taken into consideration in the FMEA and the EIS by analyzing a breach scenario.

The DEIS states: "In accordance with National Environmental Policy Act (NEPA) guidelines, failure scenarios selected for analysis in the DEIS were of relatively low probability and a comparatively high level of consequence." Further, the DEIS describes that a catastrophic failure, such as a total embankment breach, was ruled out as an extremely unlikely, "worst-case," scenario. However, given the occurrence of multiple large-scale tailings dam releases in recent years at modern operating mining facilities, the possibility of a dam breach may not be too remote and speculative. For example, breach and inundation analysis are regularly required for environmental assessments for mining projects in Canada since the Mt. Polley dam failure. We therefore also recommend that the EIS include additional information describing how the agency determined which release scenarios to model.

We recommend that the Corps develop a breach scenario and consider using the following recent approaches for estimating tailings release volumes based on evaluations of tailings facility failures. "Tailings Dam Failures: Updated Statistical Model for Discharge Volume and Runout (Larrauri, P.C. and Lall, U. 2018) and "Floods from Tailings Dam Failures" (Rico, M. , Benitio, G., and A. Diez-Herrero 2008.

Consideration of Water Treatment Plant Residuals

The DEIS does not appear to consider the impacts of WTP residuals in the fate and impacts of the pyritic TSF spill scenario. The Pebble Project proposes that both liquid and solid treatment residuals (precipitates) will be disposed into the pyritic TSF. In water treatment, one of the chemicals noted as being used is sodium hydrosulfide (NaHS), which will dissolve into HS^- and Na^+ ions and the HS^- will sequester metals to form metal sulfide precipitates in the water treatment process where it is used. If there is any residual dissolved HS^- in the water disposed of in the pyritic TSF, and it is released in a spill to surface or groundwater having a pH less than 7 (the pKa), the equilibrium reaction [H_2S (aq) = HS^- + H^+] will begin to shift to the left and form dissolved hydrogen sulfide, which is highly toxic to fish at very low concentrations (0.002 parts per million maximum acceptable for aquatic life under the EPA's National Recommended Water Quality Criteria[68]). Depending on pressure and temperature, some H_2S (aq) may be converted to H_2S gas. Additionally, oxidized and reduced precipitates and membrane reject from water treatment are going to be placed into the pyritic TSF. Some of these are at high concentrations (see Table 4.18-13). When oxidized precipitates are exposed to anoxic conditions, they undergo reductive-dissolution; when reduced precipitates are exposed to oxic conditions, they undergo oxidative-dissolution. Reactivity of the precipitates will depend on the exact conditions in the TSF at points in time and over time. Therefore, the supernatant and leachate associated with the pyritic TSF may have different water chemistry over time that isn't reflected in the modeling referenced in the DEIS or the pre-mining leaching tests. Additionally, when introduced to the environment, changes in pH and ionic strength could mobilize any metals/metalloids that are sorbed to the iron precipitates or oxidize elemental selenium to mobile selenite or selenate, for example. We recommend that the discussion of

[68] https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table

fate and behavior of released tailings from the pyritic TSF be revised to include analysis and disclosure of the impacts of a spill including both the liquid and solid treatment residuals.

Impacts of Spilled Concentrate and Tailings

We recommend that the EIS analysis of metal leaching and acid production associated with spilled concentrate and tailings be revised to more accurately reflect the anticipated fate and behavior of the concentrate and tailings particles in the environment. The EIS would be strengthened by additional consideration of the role of oxygen in aquatic environments, timing for release of mineral components, and reactivity in porewater, in order to support conclusions regarding the potential environmental impacts of spills of these materials. Based on these revisions, we recommend that discussions of impacts to resources be updated in the EIS. Our specific technical comments regarding the discussions of environmental fate and behavior of spilled concentrate and tailings (Sections 4.27.4.3 and 4.27.6.3), and recommendations to address issues identified, are described below.

Oxygen in Aquatic Environments: Throughout the spill risk chapter, there are many instances where it's stated that solids released from spills (concentrate and tailings) would not generate acid in aquatic environments because the water would "prevent oxidation of the sulfides," that "almost no oxygen gas would be present in still water," and similar statements. However, the DO content of any water body depends on multiple factors, including the depth of the overlying water and the microorganisms present to use up any existing DO. Diffusion of oxygen through a deeper water layer and through tailings porewater limits oxidation of sulfides in a TSF using subaqueous disposal; however, it will not completely stop oxidation unless the water has essentially zero DO and is a reducing environment. Additionally, if ferric iron is present (such as near the reacting surface) from oxidation of chalcopyrite or pyrite, it will catalyze the oxidation of the sulfides.

In a potential spill scenario, concentrate, tailings, or PAG waste rock will have the potential to oxidize unless the particles settle into, and remain in, an anoxic and reducing environment. The DEIS characterizes the baseline surface water resources generally being "well-oxygenated, low in alkalinity…" (pg. 3.18-7). The DEIS states that mean DO concentrations across the analysis area are 10.2 to 10.5 mg/l for streams and 2.6 to 9.1 mg/l for groundwater wells, and the saturation concentration for the altitude of the site and at 4 °C is given as 12.3 mg/l. Based on this information, we recommend that the discussions throughout the spill risk analysis be revised to accurately reflect potential for, and consequences from, oxidation of minerals from concentrate and tailings particles resulting from spills in the aqueous environments.

Time Required for Particles to React: The DEIS includes many statements asserting that timing for acid generation "requires years to decades." Whether this assertion is true with respect to metal leaching and acidity depends on the site-specific water quality parameters (pH, redox, temperature, microbial community, other ions or particulates in the water, etc.), particle size, and specific mineral composition. The DEIS does not provide data to support conclusions related to reaction time and appears to misrepresent information found in the reference materials. For example, the DEIS states that "Geochemical studies on rocks from the proposed mine site indicate that PAG material present in the tailings may require up to 40 years under local conditions to generate acid (SRK 2018a)" (pg. 4.27-68). However, the reference (SRK 2018a) states: "Some PAG components will become acidic as soon as exposed to oxygen but the median on-set period is 10 years (under site conditions). All PAG rock is expected to be acidic after 20 years of exposure unless managed to limit oxygen availability." The Summary Section of the Supplement to the EBD (PLP 2018a) states: "Kinetic testing of the rocks

showed that acidic leachate was produced from rocks with low levels of neutralization potential. Under field conditions, onset of acid generation is expected to be delayed by at least two decades, based on observations from weathering of core on site, laboratory and field based kinetic testing, and information derived from stored bag tests." The references SRK 2018a and PLP 2018a present different conclusions, both of which differ from what is presented in the EIS. We recommend that the EIS accurately discuss the reference information. We recommend verifying which reference accurately reflects the anticipated onset of acidic conditions in the waste and tailings storage areas that are representative of the current proposed project, and then updating the reference(s) and EIS discussions, including the analysis of fate and behavior of spilled tailings, to reflect that data.

The DEIS also states: "No measurable metals would be leached from deposited tailings solids because the process of ML would require decades (Section 3.18, Water and Sediment Quality)" (pg. 4.27-81 for bulk TSF; pg. 4.27-99 for pyritic TSF). The referred section of the DEIS states: "Paste pH results for aged rock cores stored at the site suggest that acidification may be delayed up to 40 years for 95 percent of the pre-Tertiary mineralized rock (SRK 2011a). Given differences in the test conditions, laboratory and field tests suggest that oxidized pre-Tertiary mineralized rock may take up to several decades for acidification to occur" (pg. 3.18-4). Because paste pH is not a kinetic test, we recommend that the EIS provide additional information to support this conclusion. In addition, rock cores are not the same as tailings that have undergone processing, which will affect reactivity. PAG tailings will weather even more quickly than the larger PAG waste rock materials (the same holds for bulk tailings vs. waste rock), if not kept from oxygen in the air or water when released into the environment, due to having a higher specific surface area for reactivity. A spill of the pyritic TSF could include both pyritic tailings and PAG waste rock, since they will be stored in the same facility. We recommend that the analyses of the fate and behavior of spilled waste materials be revised to reflect these considerations.

The concentrations of ions and acidity released into pore water and surface water, which will depend on the amount of particles not recovered, and the extent of their dilution are what will dictate if there are any short or long-term, local or broad-ranged adverse impacts. While it is true that acid generation and metal leaching from the concentrate and tailings particles will not cause immediate acute impacts, there will be potential for post spill impacts (potentially acute as well as chronic toxicity, given the very low concentration of copper [and other ions, such as mercury, arsenic, and silver] causing toxicity to aquatic and benthic organisms) from leaching of particles not recovered. This is because smaller particles have a larger specific surface area for reactivity to oxidation (in air or water with dissolved oxygen). In areas where flowing water is rapid, if there is only a small mass of particles, acid generation might be diluted quickly and might not be an immediate issue to aquatic organisms; however, in areas of slower flowing water, the acid-forming (and propagating) reactions could be prevalent in shallow pooled water or in pore-water and influence benthic organisms, as well as developing concentrations of metals high enough to influence overlying water and hence fish. We recommend revising all discussions of leaching and acid production in the EIS to more accurately reflect the anticipated behavior of the concentrate and tailings particles in the environment. Based on these revisions, we recommend that discussions of impacts to resources also be updated accordingly.

Three references that might be useful for the topic with respect to post tailings spills are Byrne et al. 2018 (stream quality post Mt. Polley spill), Kossoff et al, 2012, and Kossoff et al. 2014.

Additional Technical Comments on Spill Risk

1. Analysis Area for Tailings and Contact Water Releases: We recommend that the Section 4.27.1.2 discussion of the affected environment for tailings and untreated contact water releases refer to the chapter figures that depict the analysis area discussed.

2. Water Use in Analysis Area: The DEIS states (pg. 4.27-3) that downstream communities use groundwater as a drinking water source. We recommend that the EIS discuss whether there is there any connection between groundwater and surface water over the affected environment for bulk and pyritic tailings and untreated contact water releases.

3. Diesel Spill Scenarios: There is significant discussion in the DEIS and reference documents that there are more frequent spills of smaller volumes of diesel than larger volumes. The scenario analyzed in the DEIS uses a spill volume of 3,000 gallons and the conclusion is that there would be an average of 1 spill of this size every 90 years. The reference (AECOM 2019a) presents an additional way to evaluate the potential for spills, but this is not included in the EIS. AECOM 2019a used the total number of smaller volume spills over 6 years from the Dalton Highway (22 spills averaging 400 gallon/spill) to indicate that there could be 5 expected spills over 20 years and 18 over 78 years – an average of 1 spill of about this volume every 4.1 years, which equals a potential cumulative spill volume of 2,000 gallons over the project life. Because small spills are more likely to occur, we recommend that this information be provided in the EIS discussion to provide a broader perspective for potential spill frequency and size.

4. Spills from the Lake Ferry: We recommend that the EIS provide supporting information for the statement that the operation of the ferry would be more secure and regulated than that of marine barges (pg. 4.27-31).

5. Extent of Spilled Tailings and Concentrate Impacts: Many sections discuss transport of tailings (and concentrate) further downstream from flushing but fail to discuss the long-term influence of these particles in the watershed. They will be continually moved around and have potential to be flushed further downstream and influence larger parts of the watershed over longer time due to their continual leaching, and eventually some will be deposited into the lakes at the mouths of the affected streams. We recommend adding discussions considering the longer-term and larger distances that may be influenced by spills of concentrate and tailings.

6. Fate and Behavior of Released Gas: The DEIS states (Section 4.27.3.2) "Natural gas pipeline releases would not be expected to cause contamination of water or soil; therefore, detailed impact assessment of leak scenarios is not included in this section." While it is true that contamination likely would be short-term (depending on the time before a leak was detected and stopped), and a scenario might not be useful, there still could be impacts to aquatic life from leaks in underwater portions of the pipeline. We recommend that the EIS discuss this potential.

7. Concentrate Pipeline Failure Rates: Regarding the potential for failure of the concentrate pipeline, the DEIS states: "Based on a 20-year operational lifetime of this proposed pipeline, external corrosion leading to failure would be very unlikely" (pg. 4.27-39). We recommend that the EIS include additional data to support this statement. Further, this statement leads to the question of how the potential for failure due to external corrosion would change if the operating life of the mine were extended by 78 to 98 years under the Pebble Mine Expanded Development Scenario. The risk of a

concentrate pipeline spill is not addressed in the Cumulative Impacts Section. To enable accurate understanding of the potential impacts associated with a longer mine life, we recommend that a discussion of this risk, including supporting data as appropriate, be added to the document.

8. Concentrate Pipeline Liner: The DEIS states "EPA (2014) points out that the potentially corrosive nature of the concentrate slurry could increase pipeline failure rates above historic failure rates due to internal corrosion. As described below under Mitigation, the concentrate pipeline would have a full internal liner that would protect against both internal and external corrosion" (pg. 4.27-39). We recommend that the EIS include additional context for the referenced information here, including acknowledging that EPA (2014) stated that the pipelines would follow standards of the American Society of Mechanical Engineers, which include protection against internal corrosion. Further, the failure rates for the copper concentrate in EPA (2014) and in this EIS are based on those from oil and gas pipelines because the failure rate of concentrate pipelines isn't known. Potential for corrosion of an internal liner (which would decrease its protection of the internal pipe surface) from the concentrate (i.e., rough material) would be higher relative to the potential for corrosion of an internal liner of an oil and gas pipeline reflected in historic failure rates. We recommend that this discussion be revised to more accurately reflect the potential for internal corrosion of the concentrate pipeline, and to explain how an internal liner would protect against both internal and external corrosion.

9. Response Capability to Respond to a Concentrate Spill: The DEIS states "There are currently no organizations in Alaska that specialize in response to spills of ore concentrates. PLP would have a spill response plan in place that would address spills of ore concentrate and other hazardous materials" (pg. 4.26-39). We recommend that a draft spill response plan be included or referenced in the EIS. Such information is important to evaluate the potential impacts of the project associated with an unanticipated spill event. Given the statement that there are no organizations in Alaska that specialize in response to spills of ore concentrates, it is particularly important to have a spill response plan available for review and comment, to ensure its adequacy with regard to response actions and timeframes.

10. Mitigation for Copper Concentrate Transfer to Marine Vessels: The mitigation discussion for copper concentrate transfer to marine bulk vessels includes lids that "would not be opened until the container is within the hold of the marine bulk carriers" (pg. 4.27-40). This is a mitigation measure against dust generation during movement of the concentrate. Please provide mitigation measures for potential loss from the ship if under adverse conditions or an accident. We recommend considering whether leaving the concentrate within the cargo containers would be a better mitigation measure against potential for loss of concentrate to the marine environment in the event of an accident.

11. Mitigation for Concentrate Pipeline: The DEIS identifies avoidance and mitigation features for the concentrate pipeline including "manual isolation and drain valves would be located at intervals no greater than 20 miles apart" (pg. 4.27-41). We recommend that the DEIS discuss whether the use of automatic valves that can be remotely activated would be a better mitigation measure.

12. Discussion of the Pipeline Rupture: The DEIS states that "[t]he automatic leak detection system would detect the leak, and the surrounding isolation valves would be closed within 5 minutes (PLP 2018-RFI 066)" (pg. 4.27-50). This doesn't seem to be a reasonable scenario, when using manual shutoff valves. Please clarify how a manual isolation valve would be able to be closed within 5

minutes of leak detection if located farther away than 3-4 miles from a responding individual or revise the scenario to be more realistic.

13. Trucking Concentrate Spill Scenario: The DEIS (Section 4.27.4.4) discusses that there were 18 spills along the Red Dog haul road over 23 years (1995-2018) and approximately 30 between 1989 and 2002. This leads the EPA to understand that there were 0.78 spills per year (based on the 23 years) or 2.3 spills per year (based on the 13 years) associated with Red Dog, without reference to how many miles were driven. However, the DEIS states "…the estimated annual spill rate for a trucking-related concentrate spill in the proposed project is 0.78×10^{-6}, which equates to an average of 0.4 trucking-related concentrate spills per year for the 66 miles of Alternative 1 road transport" (pg. 4.27-42). We recommend that the EIS clarify that the 0.78×10^{-6} is per truck mile, as well as include some detail from the reference for how this number was reached. We also recommend verifying the calculations, as the annual tonnage of concentrate for Pebble used in the reference differs from the PLP project description (Appendix N), as well as demonstration how the 0.78×10^{-6} was calculated from the Red Dog data. Additionally, we recommend discussing any limitations associated with these values.

    The diesel spill scenario utilized the maximum spill volume on the Dalton Highway. However, the concentrate spill scenario (Section 4.27.4.7) assumed a spill of 80,000 pounds rather than the maximum reported spill of 145,000 pounds. We recommend that the 145,000-pound spill scenario be evaluated in the EIS.

14. Potential Impacts of a Concentrate Spill to Wetlands: The DEIS states "Although the concentrate is not expected to affect wetlands through acid generation or ML…" We recommend that the EIS clarify that this is in the short-term, as over time these particles will react unless they are buried in anoxic and reducing environments (which is more likely in a wetland than in an open river/stream).

15. Potential Impacts of Concentrate Spill to Lake Iliamna: Regarding potential impacts of the concentrate pipeline rupture, the DEIS states "Depending on the volume and location of the spill, some of the concentrate could be transported downstream into Iliamna Lake or Iliamna Bay, where it would settle out as deltaic deposits" (pg. 4.27-53). We recommend that the EIS include additional details to support the analysis of potential downstream impacts of a concentrate pipeline spill. For example, we recommend analyzing the distance concentrate would travel under various spill scenarios, whether concentrate would be transported into Lake Iliamna or Iliamna Bay, and the potential environmental impacts of concentrate deposition in those waterbodies.

16. Impacts of Concentrate Pipeline Spill vs. Concentrate Truck Spill: The DEIS asserts that impacts of a concentrate spill from a pipeline would be similar to that from a truck spill (pg 4.27-55). This statement is not supported by information provided in the DEIS. We recommend that the analysis be revised to acknowledge that the truck and pipeline spills will differ in that the trucked concentrate will be filtered and relatively dry and the pipeline concentrate will be a slurry and contain process water and chemicals. The concentrate transported via pipeline has an aqueous phase that not only will contain residues of chemical reagents, but will also contain dissolved copper, which is highly toxic to aquatic life. One of the potential chemical residues is hydrogen sulfide from any residual sodium hydrogen sulfide, dissolved H_2S is highly toxic to fish at very low concentrations. We recommend that the EIS include analysis of the potential short and long-term impacts from dissolved copper in the concentrate aqueous phase on all the resources discussed. We also recommend considering the potential effects if dissolved hydrogen sulfide is present in the mixed water source if

pH is less than 7 (background pH ranges indicate that some areas have acidic pH, so would react with the NaHS).

17. Discussion of Chemical Reagents: The DEIS includes the following statements regarding xanthate: 1) "The EPA reports that the presence of xanthate would render the tailings slurries toxic; but that if released in a spill, degradation and dilution would render the downstream waters non-toxic (EPA 2014)." (pg. 4.27-60); 2) "The EPA reports that this type of tailings slurry would be toxic due to the presence of xanthate (a reagent), but that if released in a spill, degradation and dilution would render the downstream waters non-toxic (EPA 2014)." (pg. 4.27-67, discussion of tailings spill); and, 3) "The EPA reports that the tailings slurries would be toxic due to the presence of xanthate (a reagent), but that if released in a spill, degradation and dilution would render the downstream waters non-toxic." (pg. 4.27-85, residual toxins from tailings spill).

    These are not accurate statements, and it appears these statements originate from taking the following statement from the BBWA out of context: "The concentration of sodium ethyl xanthate was not estimated in the receiving streams. Although the aqueous phase of the tailings slurry would be toxic due to xanthate, we expect that xanthate would occur at non-toxic levels in ambient waters below TSFs due to degradation and dilution (Xu et al. 1988)." This statement was made in Chapter 8 of the BBWA (Water Collection, Treatment, and Discharge) and regarded TSF leachate entering ambient water, as is clear from the "in ambient waters below the TSFs." Additionally, it was qualified (Chapter 8, Uncertainties) by the statement: "If xanthate does not degrade rapidly in the tailings, the estimate that it would not leach into streams at toxic concentrations could be incorrect." Specific to spills of chemicals, EPA 2014 stated: "Given the liquid form and toxicity of sodium ethyl xanthate (Section 8.2.2.5), it is expected that a spill of this compound into a stream along the transportation corridor would cause a fish kill. Runoff or groundwater transport from a more distant spill would cause effects that would depend on the amount of dilution or degradation occurring before the spilled material entered a stream." The EPA 2014 reference did not include discussion of sodium ethyl xanthate at all in the TSF failure scenario. Reference to it in Chapter 9 is: "However, those results do not include process chemicals (e.g., xanthates and cyanide) that may be associated with the supernatant but that are not quantified in this assessment."

    We recommend either deleting these statements or revising them to accurately reflect what the EPA reported in the BBWA regarding sodium ethyl xanthate.

18. Discussion of NaHS: The DEIS states "Sodium Hydrogen Sulfide (NaHS) is very soluble, and if spilled into water it would dissolve, and give off nitrogen oxides and sulfur oxides (PLP 2018-RFI 052)" (pg. 4.27-60). The reference document referred to states "The decomposition products include nitrogen oxides and sulfur oxides (Cayman Chemical Company, 2013)." The Cayman reference is a Safety Data Sheet,[69] which states the decomposition products are sodium oxides and sulfur oxides. Additionally, these are decomposition products, not dissolution products. NaHS will dissolve in water to release HS^- and Na^+ ions. We recommend revising the EIS discussion for clarity.

19. Spill Rates: The EIS notes that the ADEC spill database has no records specific to spills of reagents from trucking, marine, or ferry transport (pg. 4.27-61). With respect to truck transport, we recommend using the spill rate in EPA 2014 (1.9×10^{-7}).

[69] https://www.caymanchem.com/msdss/10012555m.pdf

20. Fate and Behavior of Released Tailings: We recommend that the EIS clarify in Section 4.27.6.3 that it is the low percentage of metal sulfides in the bulk tailings that would cause a lower risk of acid generation, relative to the pyritic tailings. Also, please explain why acid or metals generated would be "produced on such a slow timescale" (pg. 4.27-65) or revise as indicated in other EPA comments on leaching and acid generation.

21. Impact of Stream pH on Tailings: In Chapter 3.18, there is discussion that pH ranged from 3.31 to 9.33 in the stream samples, with the NFK having the lowest pH and UTC having the highest. The bulk tailings pipeline scenario discusses a spill into the NFK. We recommend including discussion of behavior of tailings particles if spilled in (and unrecovered from) reaches having acidic pH, since some areas are naturally acidic.

22. Discussion of Dam Failure Rates: When making the statement that "regarding dam failure rates and height of dams, higher dams have historically *not* failed more than lower dams…" (pg. 4.27-70), we recommend providing a reference to the height being compared, and point out the fact that, historically, the numbers of higher height dams (e.g., > 300 ft) in existence was fewer.

    The DEIS also states "A review of ICOLD data reveals a clear trend in the higher probability of dam failure during active dam operations. Ninety percent of tailings dam failures have occurred in active dams during operations, as opposed to dams in closure (ICOLD 2018). Data also show that failures of tailings embankments under dry storage conditions (with no ponded water above tailings) after mine closure is small compared to dams in active operations with ponded water (Donlin Gold EIS 2018). Therefore, the probability of a failure of the bulk TSF in closure would be expected to be even lower than the estimates above (EPA 2014)." (pg. 4.27-71). We recommend that the EIS explain how the EPA 2014 assessment relates to the rest of the paragraph discussing data reviewed from a 2018 reference, or how it could relate to estimates in previous paragraphs for this document.

23. Emergency Action Plan: There are several places in the DEIS where an emergency action plan is mentioned (e.g., pg. 4.27-72). We recommend that a draft emergency action plan be included or referenced in the EIS, to support conclusions regarding what actions would be taken and residual impacts that could remain.

24. Centerline vs. Downstream Dam Construction: The DEIS states that centerline construction was selected for the bulk TSF to "limit the footprint and volume of materials required for construction." It also states that "Data on dam failures around the world demonstrate that dams designed with downstream construction methods are less likely to fail than dams using centerline construction methods, especially under seismic shaking (ICOLD 2018)." (pg. 4.27-73). Because stability against failure is important, we recommend that the Corps consider this in identifying the LEDPA, since a limited footprint and lower volume of construction materials may not outweigh the inherent increased resilience of a downstream dam in considering potential for failure as compared to centerline construction.

25. Modeling Release Scenarios: The tailings release scenarios were modeled to determine the inundation (Section 4.27.6.9). As with any model, we recommend that the EIS include discussion of uncertainties associated with the modeling and how the uncertainties could impact model results. In addition, we recommend that the further information be supplied to describe how the volume of pyritic tailings released was selected since the volume appears to be less than what would be

expected based on recent studies of tailings failures (see references under Bulk Tailings Release Scenario).

26. Blasting Residuals: The DEIS asserts that bulk tailings and pyritic tailings would not contain residue from blasting agents, and states "This rock would be monitored until explosive residues have been leached (PLP 2018-RFI 021c)" (pg. 4.27-85 and 4.27-104). Such monitoring would be unusual, and the statement does not appear to be accurate as the discussion in the cited reference refers specifically to runoff from embankments. The October PLP project plan also discusses this in context to the rock for embankments. Additionally, nitrate and ammonia are noted in K4.18 as being components in water from both TSFs. We recommend that the EIS discuss the potential for blasting residues to be in the tailings' supernatant water, and analyze the potential impacts in the spill scenarios.

27. Discussion of Sediments: The DEIS includes contradictory statements with respect to the potential for entrained tailings in existing sediments to release ions (pg. 4.27-85 and 86). We recommend that the EIS clarify why they would behave differently in the situations, or that the discussion be revised.

28. Pyritic TSF Spill Scenario: In order to better understand the extent and magnitude impacts of this scenario, we recommend that the inundation maps included in the reference (Knight Piésold 2018p) be added to the EIS in this section or in an appendix.

29. Water Management Pond Release Probabilities: The probability of release from the WMP isn't presented because it is stated that "there are no known precedents for such a large lined WMP; therefore, there are no reliable statistics on their failure rates." (pg. 4.27-115). We recommend that the EIS provide information on known failure rates for ponds that approach the same size (or the largest that is common), either with or without a liner, to support the DEIS analysis.

30. Wetlands Impacts Due to Spill Scenarios: In discussing release from the WMP, wetland vegetation is stated as being impacted through uptake of contaminants because of the scenario being set in early spring. We recommend also discussing this potential with respect to metals in supernatant from the concentrate and tailings spills.

31. Fish Impacts Due to Spill Scenarios: The DEIS states that "the low-level use of the habitat to be impacted (based on the distribution and densities of juvenile and adult salmon observed in the area) indicates that drainage-wide or generational impacts to populations of salmon from direct habitat losses associated with the scenario would not be expected" (pg. 4.27-88). We recommend that the EIS define what losses are expected, and explain, for example, the significance of the loss of a year-class of salmon from the NFK within the context of population diversity.

INDIRECT AND CUMULATIVE IMPACTS

The cumulative nature of project impacts to streams, wetlands, lakes, and ponds and the fishery areas they support in multiple watersheds is an important consideration for both the EIS and the 404(b)(1) Guidelines review. The Guidelines require the prediction of cumulative effects to the extent reasonable and practicable.[70] Our key issue is a recommendation for further analysis to support the Corps'

[70] 40 C.F.R § 230.11(g)(2).

conclusions regarding potential cumulative impacts of the Pebble Mine Expanded Development Scenario as explained in greater detail below.

Pebble Expanded Development Scenario

General Recommendations: The evaluation of cumulative impacts in the DEIS presents impacts in general terms, with little or no quantitative evaluation of additional impacts resulting from this scenario. For example, page 4.18-36 states, "The potential for cumulative impacts on surface groundwater, and sediment would increase substantially," but the DEIS does not attempt to estimate the magnitude, duration, or extent of these impacts. In addition, the DEIS does not recommend mitigation measures to reduce impacts. In our scoping comments, we recommended that the EIS evaluate the expansion and continued operation of the currently proposed project as a reasonably foreseeable indirect effect of the proposed action. We recommend that the EIS include a more robust evaluation of the indirect and cumulative effects of reasonably foreseeable future activities, particularly in terms of the Pebble Mine Expanded Development Scenario.

Description of Expanded Development Scenario: The DEIS provides a summary of the Pebble Project Expansion in Table 4.1-2. While this summary is helpful, more information is recommended to support the subsequent impact assessment. We recommend that the table be expanded to provide the estimated amounts of ore and waste rock that would be mined and the amount of tailings produced. We also recommend that the table include a footnote that summarizes the uncertainty associated with the assumptions in the table (e.g., the first few sentences of the RFI-062 response). In addition, we recommend that the figure in RFI-062 be included in the EIS so that the layout and size of the mine site components can be visualized.

Future impacts of the Pebble Project Expansion will vary depending on which alternative is selected in the Record of Decision for the current proposed action. Assumptions for the Pebble Project Expansion presented in Table 4.1-2 include construction of a concentrate pipeline and diesel pipeline from the mine site to a deepwater loading facility in Iniskin Bay. Under Alternative 1, this would include construction of a second road for pipeline servicing, whereas the project access road could be used for servicing pipelines in Alternative 2 and 3. In addition, assumptions in Table 4.1-2 for the Pebble Project Expansion under Alternative 1 include continued use of the ferry to transport supplies and molybdenum concentrate to Amakdedori Port. However, under Alternative 2, it is assumed that the ferry would be discontinued after 20 years and that a road would be constructed to connect the two ferry terminals to transport supplies and molybdenum concentrate to Diamond Point port. Neither the DEIS nor RFI-062 explain why continued use of the ferry is anticipated under Alternative 1 but not Alternative 2. We recommend that this be clarified in the EIS. In addition, we recommend that the Corps consider the cumulative impacts of future expansion when considering which alternative is currently environmentally preferable.

Pebble East: The project applicant has proposed mining the deeper Pebble East portion of the deposit,[71] potentially during a future phase using surface or underground mining techniques. We recommend that mining this this portion of the deposit (Location Alternative 006) be included as part of the expanded mine scenario or that the EIS explain why evaluating the impacts of mining the deeper Pebble East portion is not reasonable or practical.

[71] Northern Dynasty Minerals, The Pebble Project: The Future of U.S. Mining and Metals, January 2017.

Resource-specific comments: Our comments regarding the analysis of impacts of the Pebble Mine Expanded Development Scenario in specific resource sections are as follows:

1. Surface Water Hydrology: We recommend that the analysis of the cumulative effects of the Pebble Mine Expanded Development Scenario on surface water hydrology (Section 4.16.7.2) include a figure or table that shows the extent of changes to surface water hydrology for the expanded development scenario so that the magnitude and extent of impacts is included. In addition, we recommend that the EIS describe the range of variability associated with the estimates of the changes so that it is clear whether these predictions are average, reasonable worst case, etc.

2. Groundwater Hydrology: We recommend that the analysis of cumulative effects of the Pebble Mine Expanded Development Scenario on groundwater hydrology (Section 4.17.7.2) include a figure that shows the extent of the groundwater zones of influence for the major mine components (TSFs, water management ponds, open pit) so that the magnitude and extent of impacts to groundwater quality and quantity is understood. In addition, we recommend that the EIS describe the range of variability associated with the estimated mine expansion described in this section (Section 4.17.7.2) so that it is clear whether the additional predictions are representative of the expanded development scenario.

3. Water Quality: The potential cumulative effects of the Pebble Mine Expanded Development Scenario on water and sediment quality (Section 4.18) are discussed in terms of the increased footprint and in terms of sedimentation and fill placement. We recommend that the impacts analysis also address the potential impacts associated with increased storage time of waste rock and tailings. Page 4.18-36 of the DEIS states, "[t]he potential for cumulative impacts on surface groundwater, and sediment would increase substantially," but the DEIS does not fully estimate the extent of these impacts.

4. Wetlands: Section 4-22 of the DEIS does not indicate how many stream miles would be lost due to the expanded mine scenario. While this section does note that an "additional 12,445 acres" of aquatic resources would be "potentially affected" at the mine site, the DEIS does not identify whether this estimate includes both direct losses and functional degradation from secondary/indirect effects, what type of aquatic resources and functions would be lost or degraded, or the severity or significance of these impacts. We recommend the EIS characterize the geographic extent of cumulative direct and secondary/indirect effects (e.g., acreage of wetlands and other aquatic resources impacted, miles of stream impacted – by impact types), the expected change in functions provided by the affected aquatic resources, and the severity or significance of these changes. Given the extensive available information about the expanded mine development scenario it appears reasonable for the Corps to include and evaluate this information. Alternatively, the Corps should explain why its current approach is sufficient in light of the significance and complexity of the discharge activities associated with this project.

5. Spill Risk: In discussion of the potential spill risk impacts associated with the Pebble Expanded Development Scenario, the DEIS states, "In summary, the cumulative effects of unintentional releases associated with Pebble mine expansion would be similar to those discussed previously in this section, but potentially involve larger volumes over a slightly larger geographic area" (4.27-128). We recommend that the analysis of impacts of this scenario be revised to include additional potential impacts not acknowledged in this statement. For example, the pyritic waste

rock (and tailings) will not be able to be placed into the pit after 20 years, will therefore not be submerged, and will be weathering over time. Therefore, a potential future spill from the TSF under the Expanded Development Scenario would be expected to have acidic and metal laden water released. We recommend that the EIS discuss potential cumulative effects from increased time of storage on water quality in the TSFs and potential for increased risk of failure of the WMP and TSFs with increased time of operation.

Potential Future Use of Cyanide: A summary of differences between the proposed project and the reasonably foreseeable expansion of the project notes that the expansion would need additional tailings storage, additional water storage, new waste rock storage facilities, additional processing facilities, a concentrate pipeline, and a deep-water loading facility. This inventory is based on RFI-062, dated August 2018. However, based on recent public statements made by Northern Dynasty Minerals (Doug Allen, Vice President of corporate communications; Vancouver Resource Investment Conference, January 2019), it may also be expected that a cyanide circuit would be proposed in the future. We recommend that the Corps verify with PLP if a future expansion of operations after the currently proposed 20-year project would include a cyanide gold-recovery circuit. If it is to be part of the reasonably foreseeable future action, then we recommend that it be added to the "Description" column of Tables 4.1-1 and 4.1-2 and impacts from that component of the project should be evaluated in the subsequent resource-specific sections.

Additional Comment on Indirect and Cumulative Impacts

Clarification of RFFAs: The DEIS states under the "Timeframe" section of the "Reasonably Foreseeable Future Actions in the EIS Analysis Area" (Section 4.1.1.3) discussion that there would be consideration of other (in addition to PLP's potential expansion) reasonably foreseeable future activities that may occur "during construction and operation of the proposed project." Table 4.1-1 presents numerous potential activities and whether they would be "reasonably foreseeable." For most activities where the table states "No – for development," meaning that the action was determined not to be reasonably foreseeable for development, there is also a statement reflecting that there is no indication that development would occur "within the operations timeframe of the proposed Pebble Project." However, for two activities having "Yes – for development" (Donlin and Drift River), there are statements that the projects are considered "reasonably foreseeable in the 78-year timeframe." It is likely that several of the projects in the table currently noted as "no" for development may actually be "yes" if looked at over a 78-year timeframe. We recommend that the criteria used to support which activities are reasonably foreseeable future actions be clarified in the EIS.

MITIGATION

The conceptual level of key project plans and design features, and some plans that are not developed at all, makes mitigation effectiveness evaluations challenging for these features and, in some cases, unsupported. Further, the draft Compensatory Mitigation Plan contains only a conceptual discussion of compensatory mitigation, does not fully address indirect impacts to waters of the U.S. that may occur, and does not identify any specific mitigation projects; therefore, the availability and effectiveness of compensatory mitigation to offset unavoidable impacts is not disclosed. These key issues are discussed below followed by additional comments and recommendations regarding the Applicant's Proposed Mitigation, best management practices, and additional mitigation being considered by the Corps.

Applicant's Proposed Mitigation

Conceptual Level of Key Project Plans and Components: Regarding PLP's proposed mitigation and procedures, the DEIS states (Section 5.2.2) "Where there is insufficient detail to determine effectiveness, the measure could not be incorporated into the impact analysis, but serves to inform the public of PLP's commitments…Engineering design and construction, operations, or closure-phase procedures are often preliminary at the time that an EIS is prepared; typically, final engineering designs and construction and operations plans are finalized during the successive state permitting phase." (pg. 5-5). We agree that designs and plans may be preliminary during EIS analysis. However, several key designs and plans proposed by PLP are either not available (Reclamation and Closure Plan, Monitoring Plan, Adaptive Management Plan, Fugitive Dust Control Plan) or at a conceptual or early stage which is less than a preliminary design stage (open pit dewatering system, TSF and WMP embankments, waste rock characterization and management plan, seepage collection/pumpback system, closure water treatment process). We recommend that these components and plans be developed with a reasonable level of detail and discussed in the EIS to support the Corps' review of their effectiveness and potential impacts in a meaningful evaluation. Our specific recommendations related to these project components and plans have been provided in our comments above (see "Conceptual level of design and development of key project features and plans").

Effectiveness and Jurisdiction of Applicant's Proposed Mitigation: The DEIS conducts an assessment of the effectiveness and jurisdiction/enforcement of each of the mitigation measures proposed by the Corps during the EIS process (Table M-1). The DEIS does not appear to include a similar assessment of PLP's proposed mitigation (Table 5-2). We recommend that the EIS conduct this same assessment for PLP-proposed mitigation identified in Chapter 5 and that columns describing effectiveness and jurisdiction/enforcement be added to Table 5-2.

List of Applicant's Proposed Mitigation: Numerous mitigation measures described in the EIS are not fully included in Table 5-2 (Applicants Proposed Mitigation Incorporated into the Project). We recommend that Table 5-2 be revised for completeness, so that a complete listing of all mitigation measures considered is available. Additional detailed comments on Table 5-2 are as follows:

1. Reclamation and Closure Plan: Our comments related to the RCP (pg. 5-6/7) include:
    - The DEIS states, "Where feasible, mine facilities would be reclaimed in such a manner as to create new wetland areas and ponds." In order to analyze impacts to wetlands at reclamation and closure, we recommend a draft RCP be developed that describes what is meant by "where feasible" and that specifically describes reclamation that would occur to create new wetland areas.
    - The DEIS states "The RCP would document the plan for long-term closure of the site in a stable condition…and would serve as the basis for the development of the closure cost estimate and associated bonding." We recommend developing a draft RCP that defines what is meant by a stable condition and documents specific plans for long term closure, or that the EIS provide some other reasonable basis for assessing the impacts at closure.
    - See also our comments regarding the RCP under "Conceptual Project Features and Plans…"

2. Bonding and Financial Assurance: Table 5-2 discusses bonding in the context of the RCP. Financial assurance would also be required by the State of Alaska for the Integrated Waste Management Permit and dam safety certification. We recommend that this be clarified. In addition, we

recommend that a draft financial assurance cost estimate be provided to enable evaluation of the adequacy of financial assurance given the need for long-term water treatment. Please see our comments on "Conceptual Project Features and Plans…" for more information.

3. Fugitive Dust Control Plan: According to the DEIS, a fugitive dust control plan would be developed and "methods would be established to control dust from vehicle travel on unpaved roads, material handling, and wind erosion from disturbed areas. Control measures *could* include speed limits, use of approved chemical dust suppressants, and application of water" (pg. 5-8, emphasis added). We recommend that a draft fugitive dust control plan be included in the EIS that specifies the control measures that would be used. This would ensure disclosure of the extent to which fugitive dust releases would be mitigated and any potentially significant remaining environmental and human health impacts. We recommend that the draft fugitive dust control plan consider inclusion of the following:
   - Site:
     - Dust control fence/barrier/plantings at perimeter of operations;
     - Establish inspection schedule to verify plan is working;
     - Establish a standard for identifying a dust event (e.g., percent opacity);
   - Processing facility:
     - Minimize ore drop distance as practicable;
     - Inspect equipment and enclosures regularly for physical integrity. Address identified issues as soon as practicable;
   - Storage piles:
     - Minimize drop height as practicable;
     - Define when water/chemicals are needed;
   - Roads:
     - Define when water/chemicals will be used;
     - Identify measures to load and transport material in trucks to minimize dust (drop height into bed, level of fill in the bed, etc.);
     - Establish a level for triggering dust control measures;
   - Drilling:
     - Address whether a wet method will be used for drilling;
     - Set limit on percent opacity;
   - Inspections:
     - Establish a regular schedule for inspection;
     - Establish a routine maintenance schedule;
     - List the schedules for watering, treating and periodic cleaning of roads, trafficable areas and storage piles;
   - Staff
     - List of staff responsible for implementation of plan;
     - All employees report high dust; and,
   - Equipment:
     - List equipment to be used (spray trucks, chemical application systems, etc.).

   In addition, we recommend that the EIS include discussion regarding the toxicity of dust suppressants (see, e.g., McTigue et al. 2016), and that this factor be addressed in the draft plan.

4. Aquatic Resources Monitoring Plan: The DEIS suggests that an ARMP would be developed at a later time in consultation with ADFG and ADNR. We recommend that a draft ARMP be included in the EIS to provide support for the conclusion in column 2 of Table 5-2 that it would monitor change to aquatic communities and allow for adaptive management to address any project-related impacts.

5. Spill Response: Table 5-2 states that the project would contract with a Spill Response Organization. As discussed in our comments on Spill Risk (Section 4.27), we recommend that a draft spill response plan be included in the EIS. We recommend that this plan identify organizations contracted to deal with all anticipated types of spills (oil, concentrate, tailings, natural gas, chemicals), as well as discuss spill response actions including actions that would be taken to notify potentially affected communities and plans for spill remediation.

6. Pit Lake: Table 5-2 of the DEIS provides a general discussion of the pit lake being maintained "at a level that promotes hydraulic containment…protecting site groundwater." And "…providing for additional storage capacity…" (pg. 5-13). It will also be very important that water level be maintained in the pit enough to keep the PAG materials in an anoxic zone (where there is no infiltration of oxygenated water). We recommend that the EIS address how these needs will be balanced, the depth required to satisfy these needs, and plans for monitoring the water level. Additionally, while final storage of the PAG materials in the pit will mitigate the need for treatment in perpetuity of seepage from the pyritic TSF or from a PAG waste rock pile (if one were proposed), the pit will require treatment and release of water, likely in perpetuity, to sustain those conditions. We recommend that this measure acknowledge the likelihood that water treatment for the pit would continue in perpetuity.

7. Waste Rock Management Plan: Table 5-2 of the DEIS identifies PLP's "primary approach" confirming use of NAG and non-metal leaching materials in construction and that it would "confirm sulfur and element characteristics" (pg. 5-13). As discussed in our comments on Conceptual project Plans and Features and Water Quality, we recommend providing more detail regarding the specific criteria and procedures that would be used to separate PAG/metal-leaching waste from NAG/non-metal leaching wastes in order to evaluate the extent to which these procedures would be effective at reducing the risk of impacts to water and wetlands from ARD and leached metals.

8. Storage of PAG Materials: Two entries in Table 5-2 describe measures that would be taken for storage of PAG Materials during operations and at closure and discuss the impacts that would be mitigated by these measures (pg. 5-15, first and second rows). We recommend revising the text to reflect that the impacts being mitigated include negating the need for perpetual treatment of runoff and seepage and potential failure of the pyritic TSF, but that the measure will result in required monitoring and treatment of the pit in perpetuity. Also, we recommend that the EIS state more accurately that the subaqueous storage will "limit" or "minimize" oxidation and subsequent acid generation, depending on the depth of the water cover and provision of anoxic and reducing conditions, but would not necessarily "eliminate oxidation and acid generation."

9. Treated Water Discharge: Table 5-2 references the use of "strategic timing" for water release at three separate discharge points, but details on the timing are not provided in the DEIS (Chapter 2 or Appendix N). We recommend that the EIS provide a reasonable description of the plans for treated water discharge, including what is meant by "strategic timing," how the goal of "minimize, or avoid, impacts to fish habitat" would be achieved, and where treated water would be stored prior to its release if there is need to release smaller amounts than what is being treated at any time. Also related

to this topic is text in 4.24 stating that "treated water would be discharged through buried infiltration chambers designed to provide energy dissipation, erosion control, and freeze protection." Presumably these are mitigation measures against damage to the streams (erosion, resuspension of settled solids, etc.) by velocity of discharge, as well as to protect aquatic life from the force of the water. We recommend that this measure be added to Table 5-2.

10. Redundancy in BMPs: The Water Quality Section includes a statement regarding potential for overwhelming BMPs "resulting in an influx of fine sediment and increased turbidity into gravel-dominated streambeds" (pg. 4.18-19). We recommend redundancy in BMPs in areas near these streams and that settling basins/ponds/ditches on the mine site be sized to consider extreme events to mitigate against release off-site.

11. Road Access: Table 5-2 states "The project would provide for controlled use of the road corridor and ferry for local residents, improving the supply of goods and reducing the cost of importing goods." However, Chapter 2 describes the road as a "private road." We recommend that the EIS define what is meant by "controlled use" to confirm general statements made here and elsewhere (e.g., Section 4.9 Subsistence) about positive benefits to community. We also recommend that the allowable use of the road be clarified in the project description.

12. Independent Review of the TSF and WMP dams: We recommend that the mitigation table include an independent review of the TSF and WMP dams proposed for the project. These are significant structures that retain tailings and contaminated water. We recommend that the Corps require independent review of these structures[72].

Best Management Practices

The DEIS defines Best Management Practices and Industry Standards as "predictable actions necessary to comply with regulations and standard permit requirements that are designed to reduce impacts to the environment. These are typically reflected in the applicant's design and are analyzed as part of the proposed project." Where such actions are presumed in the analysis of the proposed project, it is important that the DEIS include the actions that will be taken and how they will be enforced. We recommend the BMPs and other standard actions assumed for the project be compiled in a new table, or that these measures be added to Table 5-2. Consistent with our recommendation for Table 5-2, we recommend that this table include the effectiveness and jurisdiction/enforcement of the measure. Many of the items listed in Section 5.2.1.2 are examples of where BMPs would be required by regulation or are likely to be used, rather than being a description of the action itself, and we recommend providing details on the anticipated measures.

As part of the description of BMPs, the DEIS discusses the Alaska Large Mine Permitting Team (LMPT) process (Section 5.2.1.1). The DEIS states "The goal of the LMPT process is to coordinate the sequencing and intergovernmental review of the numerous permits required of a large, complex, hardrock mine." However, the DEIS mentions only three of the state permits/approvals: the Plan of Operations approval, Reclamation and Closure Plan approval, and Integrated Waste Management Permit as being part of an application package and subject to public comment. We note that the state also issues air quality permits, Alaska Pollutant Discharge Elimination System permits, dam safety certifications, water rights, and fish habitat permits for mining projects and these permits/approvals are not discussed.

[72] 33 CFR 325.1(d)(6)

We recommend that this section be revised to clarify whether these other major state permits/approvals are part of the LMPT process or if they are processed separately.

The DEIS provides numerous steps that are conducted for the State LMPT process, but does not explain where the Corps' 404 permitting and the NEPA process factor in to the state's process. Under the section for the Applicant's Proposed Mitigation Incorporated into the Project, there is a statement that designs are often preliminary in the EIS and are "finalized during the successive state permitting phase", which implies that the 404 permitting phase occurs first. We recommend that the EIS clarify the timing of the Corps' 404 permit application and NEPA process in relationship to the state and local processes when discussing the state and local processes.

Compensatory Mitigation

Appendix M contains the applicant's draft conceptual Compensatory Mitigation Plan (CMP). Our primary comments on the CMP is lack of proposed mitigation projects, lack of inclusion of temporary and secondary impacts, and functional assessment is not considered. These issues are discussed below. Our letter on the CWA 404 Public Notice (see Section I.X. of the letter) also reflects these issues and discusses the CWA 404(b)(1) Guidelines.

The CMP provides summary information regarding the compensatory mitigation regulations, the potential impacts, and potentially affected watersheds. It states that PLP proposes to compensate for 3,524 acres of direct permanent losses of waters of the United States. It also states that "PLPs compensatory mitigation approach will focus on opportunities that benefit water quality and fish and their habitat. While the intent is to seek such opportunities within the watershed, if opportunities are not available PLP will reach for similar opportunities outside the watershed." The CMP does not include any proposed compensatory mitigation projects or information regarding type and location of compensatory mitigation under consideration. It states that "[t]his CMP will be amended in the future to include proposed mitigation plans." The DEIS states (pg 5-23) that "[s]pecific mitigation conditions would be determined following completion of the environmental review and would be included in the ROD for any permit that may be issued."

The Corps should provide an opportunity for meaningful public comment on a CMP that includes a level of detail "commensurate with the scope and scale of the impacts" as well as the "amount, type, and location" of compensation they could potentially provide. Alternatively, the Corps should further explain why, considering the scope and scale of the impacts associated with the proposed project, the CMP contains the level of detail and information required by the public notice regulations at 40 C.F.R. § 230.94(b)(1). In addition, the Corps should explain why the information included in the public notice provided the public or other federal agencies with an opportunity to provide meaningful comment or recommendations on the proposed mitigation as contemplated by the regulations. The Corps should further explain why the CMP complies with the requirements under Section 404 discussed above or the NEPA requirements that mitigation measures be discussed in the EIS sections on alternatives and environmental consequences.[73] This is particularly important in light of the significance and complexity of the discharge activities associated with this project.

[73] 40 C.F.R. § 1502.14(f) and § 1502.16(h).

The Guidelines identify that "[c]ompensatory mitigation requirements must be commensurate with the amount and type of impact that is associated with a particular DA permit."[74] They also specify that "the amount of required compensatory mitigation must be, to the extent practicable, sufficient to replace lost aquatic resource functions."[75]

The CMP indicates that PLP proposes to compensate for 3,524 acres of direct permanent losses of waters of the United States. As discussed in our DEIS comments, the DEIS may not have accounted for and characterized all of the potential direct and secondary/indirect impacts of the discharges of dredged or fill material. In addition, the CMP does not address potential compensatory mitigation for the other impacts acknowledged in the DEIS: the direct impacts to over 80 linear miles of streams, the temporary impacts to 510 acres of wetlands and other waters, and the more than 2,800 acres of secondary/indirect impacts to wetlands, streams and other aquatic resources. We recommend that PLP's revised CMP explain how the amount of compensation reflects the amount necessary to meet applicable requirements for the full scope of direct and secondary/indirect impacts of the discharge of dredge and fill material. This information is particularly important in light of the significance and complexity of the discharge activities associated with this project.

The factual determinations underlying the Corps' Guidelines conclusions involve a determination of "the nature and degree of effect that the proposed discharge will have, both individually and cumulatively, on the structure and function of the aquatic ecosystem and organisms."[76] "Compensatory mitigation requirements must be commensurate with the amount and type of impact"[77] identified and "sufficient to replace lost aquatic resource functions."[78] The Guidelines state that where functional assessments are available (as they are here), they should be used to determine the amount of compensation that would be sufficient to offset the authorized impacts.[79] Functional assessments provide a mechanism to quantify the extent of functional loss (debits) and functional gain (credits). Debits represent the loss of function at the impact site, while credits represent the accrual or attainment of aquatic functions at a compensatory mitigation site.

The Corps Alaska District has a Credit Debit Methodology that uses function or condition data to quantify the functional losses or gains between the current and proposed future condition. These functional deltas are used to calculate debits and credits, as recommended by the regulations.

Data was collected that could support development of a functional assessment to identify the amount of functional losses resulting from impacts to wetlands and other aquatic resourced and inform compensatory mitigation decisions. However, this data was not used in the DEIS. As discussed in our DEIS comments on wetland and fish, additional information and analysis is recommended to identify the amount of losses specifically associated with fish-related functions. This information and analysis are important to informing decisions regarding the appropriate type and amount of compensation necessary to offset impacts to fish and fish habitat. We recommend that the Corps should use available data that was collected to support aquatic resource functional assessments and supplement that data where necessary, particularly to identify the amount of losses associated with fish-related functions and use this information to inform decisions regarding the appropriate type and amount of compensatory

[74] 40 C.F.R. § 230.93(a)(1).
[75] 40 C.F.R. § 230.93(f)(1).
[76] 40 C.F.R Section 230.11(e).
[77] 40 C.F.R. § 230.93(a)(1).
[78] 40 C.F.R. § 230.93(f)(1).
[79] 40 C.F.R. § 230.93(f)(1) and 73 FR 19633 (2008).

mitigation necessary to offset the expected functional losses from the proposed Pebble Project. These analytical steps are particularly important in light of the significance and complexity of the discharge activities associated with this project.

Monitoring and Adaptive Management

The DEIS states that PLP proposes to use monitoring measures through construction, operations, and closure of the proposed project to assess predicted impacts and effectiveness of mitigation. The monitoring would have an adaptive management component to identify, assess, and implement changes to the required mitigation measures. The DEIS does not include or reference any specific monitoring or adaptive management plans. The DEIS states that the monitoring plan would be developed during state permitting. As discussed in our comments under Conceptual-level of Design and Development of Key Project Features and Plans, a reasonably detailed monitoring plan and adaptive management plan(s) is important for the EIS analysis. Otherwise, there is no basis for assuming that the monitoring plan (at unspecified locations, frequencies, parameters, etc.) would be effective at detecting changes and no basis for assuming that unspecified adaptive management would be successful at correcting mitigation measures. We recommend that reasonably detailed draft monitoring and adaptive management plans be included in the EIS.

Additional Comments on Mitigation

Appendix M – Additional Mitigation: We appreciate that the Corps has identified additional mitigation measures (Table M-1) beyond those proposed by PLP. Our specific comments on Table M-1 are as follows.

1. Table M-1 identifies numerous proposed mitigation measures that could "indirectly" be enforced by the Corps. We recommend that the EIS define what is meant by the term "indirectly."

2. Table M-1 presents some proposed measures having "jurisdiction/enforcement" noted as "not likely to be enforceable due to remoteness of the project area." Although the project area is remote, and perhaps enforcing compliance couldn't be done daily, projects such as this may still be monitored and/or audited. We recommend that the EIS clarify why a requirement, if made, would be unenforceable solely because of it being a remote project.

3. Automatic isolation valves for concentrate pipeline variant are listed as a "possible" measure in Table M-1 (pg. M-5). The DEIS evaluates a tailings release scenario from the bulk TSF due to a pipeline rupture (Section 4.27.6.9), and states that it would take six hours to detect the leak and shut off the pumps. We recommend that automatic isolation valves, as well as use of a leak detection system, be further assessed as a mitigation measure since it would enable a quicker response to pipeline incidents and minimize the impacts of a pipeline accident or malfunction.

4. Table M-1 lists a double liner system under the pyritic TSF and main WMP as "possible" (pg M-6), but concludes that a double-liner is not reasonable since these facilities already include a liner and a seepage collection system. Minimal information regarding the design of the seepage collection system is provided in the EIS and therefore, it cannot be assumed that it would be effective in preventing groundwater contamination. We recommend that either a double-liner be considered, or additional information be provided regarding the seepage collection system.

5. We recommend revising the Table M-1 to correctly identify that the discharge of bilge water is not under the jurisdiction of the State of Alaska (pg. M-4) and acknowledge that the EPA Vessel General Permit is currently the mechanism by which treated bilge water discharges are regulated. We also note that in the next few years, this authority will transfer to the US Coast Guard (under the Vessel Incidental Discharge Act of 2018).

6. We recommend that additional air quality mitigation measures be added to Table M-1.
    - Regarding use of dust palliatives to reduce fugitive dust, we recommend including a commitment to implement non-toxic palliatives/dust BMPs;
    - As noted in our comments on air quality, the proposed port facility has very high NOx emissions. We therefore recommend considering using access to natural gas to generate shore power to provide to the vessels while they are in port, rather than having the vessels idle, which would significantly reduce NOx at that location; and,
    - We recommend use of the highest Tiered vehicles available for all mobile sources, to reduce engine emissions.

7. Additional mitigation is suggested in several areas of the DEIS that is not identified in Table M-1. We recommend that this additional mitigation be included in Table M-1, including the following:

    - Appendix K4.15 (Geohazards) identifies concerns related to the possibility of uneven deposition of tailings around the perimeter of the bulk TSF that could lead to smaller tailings beaches and added seepage pressure on the embankments. Deposition of tailings on ice in the winter is mentioned as a possible method to mitigate this effect (Pg. K4.15-9). We recommend that this mitigation be added to Table M-1.

    - An additional concern identified in Appendix K4.15 was the possibility that weak foundation conditions (such as a buried glacial clay layer) could be undetected by geotechnical investigations which could result in a very low to low probability of global instability. The DEIS notes that as a result PLP proposed a design change to remove overburden to competent bedrock (pg. K4.15-20). However, that design change is not included in the Project Description. Therefore, we recommend that this be included in Table M-1.

    - Chapter 4.18 (water quality) and AECOM 2018i noted concern that salt and selenium could build up over time that could lead to increased TDS and selenium concentrations that could not successfully be treated. It was concluded that further investigation and mitigation measures or improved management processes are recommended to ensure that WTP performance will meet treatment goals. We recommend that additional mitigation or treatment system adjustments be identified in Table M-1 with enough detail and added analysis to demonstrate that it would improve WTP performance to meet water treatment goals.

Additional Mitigation: Our DEIS comments have noted significant deficiencies with the level of detail associated with key aspects of the project and the environmental analysis that effects the ability to assess the level of environmental impacts. After these deficiencies are corrected and the impact assessment revised, we may recommend additional mitigation measures be included.

AVAILABILITY AND USE OF DATA

As discussed above, data gaps related to important but conceptually developed project components are a key issue for the EIS. Our recommendations regarding data gaps as well as additional recommendations regarding data use and information disclosure are provided below.

Data Gap Analysis

Our comments regarding the specific data gaps identified in Section 3.1 are as follows:

Reclamation and Closure Plan: The DEIS identifies lack of a detailed reclamation plan as a data gap since "a detailed reclamation plan is potentially essential to a reasoned choice among the alternatives." We agree and, based on our comments above (see "Description of the Proposed Project"), a reasonably detailed reclamation and closure plan is important in order to determine reasonably foreseeable significant adverse impacts during the reclamation and closure phase of the project.

Subsistence: The DEIS identified lack of current (post-2008) subsistence data as potentially essential to making a reasoned choice among the alternatives. The DEIS states that it is common that current site-specific information on subsistence use are not available during NEPA compliance, although no references are cited for this statement. There are examples where current traditional knowledge and/or subsistence data was gathered for mining EISs where subsistence was determined to be a significant issue (e.g., Red Dog Aqqaluk SEIS, Donlin Gold EIS). We recommend that the Corps consider acquiring more recent data given the importance of the subsistence resources or further explain why the current analysis is sufficient.

Other Data Gaps: The DEIS states there are only 4 data gaps based on data gap analysis; however, as discussed in our comments on other sections of the DEIS, other data and information gaps exist and the extent of data gaps is underestimated. Some of the other data gaps are mentioned throughout the DEIS. We recommend a more complete accounting of relevant data gaps in the DEIS and a discussion regarding how the gaps impact the accuracy of the EIS conclusions (e.g., especially along the transportation corridor and the ferry and port sites). Examples of where other data gaps are mentioned in the DEIS or are otherwise apparent include (see our comments on Chapter 2 and Chapter 4 sections for details) – note these are just examples as more data gaps are apparent:

- Lack of a detailed waste management plan that would include criteria and specific details regarding how metal-leaching vs. non-metal leaching wastes will be separated;
- Lack of a seepage collection and monitoring/pumpback well system design for the TSFs and water management ponds;
- Lack of compensatory mitigation projects;
- No monitoring or adaptive management plans, beyond general statements and several examples that monitoring and adaptive management would occur;
- Embankment designs lack detail to support seismic stability analysis and seismic stabilty analysis was not conducted was not conducted on some of the embankments;
- "[N]o existing estimate of recreational use at the mine site…" (pg. 3.5-14). This is also true at the port site and along the transportation corridor;
- No stream gages along mine access road or spur road (Fig 3.16-4);

- "Streamflow information for the other streams crossed by the road is not available at the time of this writing… Drainages in the analysis area south of Iliamna Lake have not been the focus of any known hydrologic studies to date." (pg. 3.16-26);
- "To date, limited geochemical testing has been performed on the representative concentrate because possible designs for metallurgical processes are still at an investigative stage." (pg. 3.18-3);
- Surface water quality along port access road;
- Groundwater quality along northern access road (1 sample collected in Pedro Bay); and,
- "No substrate data is available for streams along the southern portion of the mine access road." (pg. 3.18-21).
- There is incomplete discussion of the importance of headwater streams and wetlands, despite the fact that these are the habitats that will be affected by the mine site. There is an extensive body of evidence supporting the idea that headwaters are critical aquatic habitats (e.g., Schlosser 1995; Wipfli 2007).

Additional Comments on Data Quality and Use

Data quality is generally discussed in the DEIS, which would be strengthened by explaining whether all the data were used, whether any were determined to be anomalous and excluded, or how decisions were made for what data were used. For example, in some cases, one-half of the detection limit was used for data that were below the detection limit, but the DEIS does not acknowledge that the number of samples having measurements below detection will influence the meaning of the mean and may indicate an analyte is present at a value above detection when most of the time it is not. We recommend that the EIS provide discussion of data quality assurance for all types of data (e.g., background surface water quality, sediment quality, and geochemical testing data) including:

1) Present all limitations on each type of data;
2) Provide the frequency of detection in the tables to assess whether the analyte is commonly present or commonly absent;
3) When presenting sample means, provide a measure of dispersion around the mean (i.e., range, standard error, standard devisions, etc.) as well as the sample size associated with generating the mean. This is important for understanding the variability and robustness of the dataset; and,
4) Include in discussions of the data how data limitations influence uses of the means determined.

In addition, we recommend that the EIS clearly indicate whether results being discussed in various sections are based on total or filtered (dissolved) samples. Finally, when using qualifiers (e.g., "Relatively high", "significantly higher", "high", "higher", "slightly higher", "slightly lower", "small"), we recommend that the EIS provide the values being compared to justify the statements.

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